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BULLETIN

OF THE

MADRAS GOVERNMENT MUSEUM

EDITED BY THE SUPERINTENDENT

THE
LAND AND FRESHWATER MOLLUSCA
IN THE COLLECTION OF THE MADRAS GOVERNMENT MUSEUM

BY

S. THOMAS SATYAMURTI, M.A., D.SC., F.Z.S.
(*Superintendent, Madras Government Museum*)

NEW SERIES—*Natural History Section, Vol. VI, No. 4.*

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1960

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(**Published — 1960**)

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THE LAND AND FRESHWATER MOLLUSCA
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COLLECTION OF THE MADRAS GOVERNMENT MUSEUM

By S. Thomas Satyamurti, M.A., D.Sc., F.Z.S.

INTRODUCTION

Of the five classes into which the Phylum Mollusca is divided, three, namely, the Amphineura, Scaphopoda and Cephalopoda are exclusively marine, while the remaining two classes, the Gastropoda and Pelecypoda, are represented in the sea as well as on land or in freshwater, although by far the majority of species of these two classes are also marine ; and among these two groups, inland species of the Class Gastropoda are found both on land and in freshwater, while the Pelecypoda are not represented on land, being purely aquatic, and are hence found only either in the sea or in freshwater ; the vast majority of species of Pelecypoda, however, are marine, only a comparatively few species being found in freshwater.

When the idea of taking up for study a systematic survey of the land and freshwater molluscs of Southern India first suggested itself to the author, it was found necessary at the outset to define clearly the scope and extent of the work before proceeding with any well planned systematic work, in view of the enormous number of species of land and freshwater molluscs that have been recorded from Southern India, and the wide range of localities from which specimens of the inland species of molluscs have been collected. So immense is the extent of this field, both in respect of the numbers of the species and the range of variability in the form, size, shape, colour and structure of the shells, even within the limits of a single family or genus, apart from the animals themselves and their soft parts, that it is perhaps no exaggeration to say that the entire lifetime of a systematist would hardly be sufficient for attempting anything approaching a complete and exhaustive account of all the species that occur even in such a well-defined and limited geographical region as Southern India. Further, a vast amount of work on these species has already been done by pioneers in this field such as Blanford, Hanley, Theobald, Godwin-Austen, Pfeiffer, Beddome, Nevill, Gude, Preston and others whose monumental works on the subject still remain our main standard source of information on Indian land and freshwater molluscs, and added to these, a large series of detailed systematic, structural and anatomical papers on Indian inland molluscs have appeared from time to time in the Records and Memoirs of the Indian Museum, contributed notably by Annandale, Prashad, H. S. Rao, Bhaduri, Seshaiya, Godwin-Austen, Preston and other workers who had worked intensively on the collections in the Indian Museum, or on collections made in particular localities, such as Barkuda Island, Inlé Lake, etc. It would therefore probably be not far wrong to say that the Indian land and freshwater molluscs have been more thoroughly studied and worked out than their marine counterpart. Particularly workers like Godwin-Austen and Annandale have paid special attention to the internal anatomy and soft parts of many of these species and have thereby thrown much fresh light on the exact systematic position of several of the more obscure species whose true relationships could not

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hitherto be correctly inferred from a study of their shells and external characters alone. The Fauna of British India Series contains four useful volumes on Indian land and freshwater molluscs by various authors, dealing with a large number of species found not only all over India, but in neighbouring countries such as Burma, Nepal and Ceylon, as well.

In view of these considerations, therefore, it was felt that it would not serve much useful purpose if all the South Indian species of inland molluscs so far recorded were to be written up and described again, since this would not only swell the size of the present volume to an unwieldy bulk, but would also render it undesirable insofar as it would largely be a needless repetition of descriptive material published elsewhere by previous authors who had done pioneering work in the field, and the immense number of species which one will have to deal with in such a work will be well nigh bewildering to the average student or systematist who wishes to have a broad grasp of the more common species and their relationship with each other in the modern scheme of classification.

However, when the author began to undertake the present work he was impressed by a few points which are worth mentioning here. Many of the older works on this subject, which date back to 1870 to 1890, are now out of print, and are available only in a few large libraries and hence not easily accessible to students, and even among these well-known standard works, some of the publications such as those by Nevill and Theobald are mere lists or catalogues which do not give the student any idea of the structure and appearance of the shell, and the standard work by Hanley and Theobald entitled Conchologia Indica (1876) is also little more than an illustrated catalogue, although the coloured illustrations in that work are on the whole very good and compare favourably with those of Reeve's Conchologia Iconica in clarity and artistic beauty. Further, the volumes of the Fauna of British India Series on Mollusca, exhaustive and descriptive as they are, unfortunately contain far too many Latin descriptions not readily understood by our students, and only a very few species, many of which are not South Indian, are illustrated in these volumes. Lastly, and this is a very important point, there is no convenient handbook at present available to the Indian student or systematist in which at least the more common and better known South Indian land and freshwater molluscs are brought together and arranged according to their true relationships in their correct systematic order in keeping with the latest classification of Molluscs available at present, the classification followed in the Fauna series and other earlier volumes being necessarily out of date and hence in many respects confusing and even misleading. Many of the old family and generic names have since changed and given place to new ones, and even familiar forms placed in a particular family or genus by older authors are now placed in an entirely different family or genus, after their true position had been established by further study. For instance, the familiar family name Zonitidae, which was employed by earlier authors and also used in the Fauna volume on Molluscs to include the majority of our land snails, now comprise quite a different series of genera under the present scheme of classification, the Indian genera formerly included therein having now been transferred to a distinct family, the Ariophantidae, under a different series altogether, the Ariophantacea ; again, the generic name *Ariophanta* formerly employed to denote all our common garden snails now includes only a relatively few species having exclusively sinistral shells, the ordinary dextral-shelled forms

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having now been separated into other genera such as *Xesta*, *Xestina* and *Cryptozona*. Another instance is that the genera *Streptaxis* and *Ennea* included under the family Testacellidae in the Fauna volume now no longer belong to that family, but are included in a separate family, the Streptaxidae, far removed in systematic position from the true Testacellidae which now includes only a single genus *Testacella*—represented only in Europe. Such instances are far too many to be quoted individually. It would be sufficient to say that there have been drastic changes in the scheme of Molluscan classification, particularly as regards land and freshwater forms. Further, if a student during the course of his field work comes across, say, a species of *Pila* or a *Melania* or a *Planispira* he is often puzzled as to where exactly he should fit in his species in the modern scheme of classification as there is no recent handy guide readily available to help him fix its correct position, for the older treatises place them under various out-moded generic names such as *Ampullaria*, *Tiara* and *Helix* placed in families which are arranged in an order which is seldom in keeping with their true systematic relationship. The need for a clear handlist of at least the commoner species in their modern sequence will therefore be readily appreciated not only by students and systematists but also by amateurs who wish to collect shells of inland species and arrange, name and classify them in a scientific way. It is primarily with the object of fulfilling this need that the present work has been undertaken. When, with this object in view, the author examined the collection of land and freshwater molluscs in the Madras Museum it was fortunately found that although there were only about 120 species in the collection out of about 400 species recorded from the whole of South India, yet these 120 and odd species were found to be fairly representative and were by far the commoner and more widely distributed ones which are likely to be met with more frequently than the others by the average collector or the interested student who sets out to look for land and freshwater shells in this region. It was further discovered that in the case of many of these species the localities from which the specimens in the Museum collection had been collected had not been previously recorded in any of the earlier publications ; there are twenty-nine such new records (*see* appendix, p. 161). In the descriptions that follow, the localities from which a particular species had so far been recorded are listed under the heading " Recorded localities ", while the localities from which the specimens in the Museum collection had been actually collected are mentioned under the heading " Specimens in the Collection ".

It was therefore felt that if a descriptive report of the Collections could be presented, complete with their synonymies, localities, measurements and illustrations, and grouped and arranged according to the modern scheme of classification, adopting the latest nomenclature for the families and genera, it would help in some measure not only in serving as an introduction to the chief types of inland molluscan species met with in Southern India but would also provide a handy guide to the student to help them towards a clearer understanding of the correct classification and relationships of the species herein described. The scope of the present work has been limited to the available collections of inland molluscs in the Museum but as these are fairly representative of the main taxonomic types found in this part of the country, it is hoped that the objects mentioned above will be fulfilled and that the book will serve in some measure to clear up the confusion that still prevails in the minds of students as to the exact systematic arrangement of the inland species of molluscs.

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The material examined consisted of specimens belonging to species which are mostly collected from localities in South India, but there are also a few forms from Ceylon, a few from some northern districts of India such as Midnapore, etc., and a very few from other foreign lands also, and these have also been included in the present account as in most instances they show close affinity to South Indian species. The collection comprises both dry-preserved empty shells, many of them with their opercula in position, and spirit-preserved specimens with their soft parts intact ; in the case of many species of land snails, especially of the genera *Euplecta*, *Ariophanta*, *Xestina*, *Cryptozona*, etc., fairly large series of specimens from various localities are contained in the collection.

Land molluscs are generally most abundant during and after the rains and are often found in moist situations such as among decaying leaves and vegetation, moist grass and moss, under barks of trees, in crevices of stones and rocks, under logs of wood and in gardens, groves, orchards and parks, sometimes sticking to and climbing on to the stems of plants, and found generally wherever there is sufficient moisture. Most of them aestivate underground during the summer and only emerge and begin to be active during the wet season. Land molluscs are particularly abundant on the hills, many species in South India having been recorded from the slopes of the Nilgiris, Pulney Hills, Shevroy Hills and Anamalai Hills. Some snails are habitually found in forests, the large Imperial Snail, *Ariophanta basileus* (now more correctly referred to as *Hemiplecta basileus*) found in the Cochin Teak forests being a classical example. Freshwater molluscs are found almost everywhere in tanks, pools, paddy fields and lakes, and are especially plenteous in water having plenty of water weeds, which are rich in calcareous content. Some species, such as the freshwater mussels, are found on sandy bottoms in clear running water, while others lie buried at the bottom in the mud of pools and tanks. However, the habits and habitats of both the inland gastropods and pelecypods vary so widely with different families, and sometimes even within the limits of the genera that it is not possible to generalize on these aspects beyond what has been stated above.

The classification followed in this paper is that of Thiele's Handbuch der systematischen Weichtierkunde, this being the latest and most complete classification of the Mollusca at present available, but as this treatise is in German and as there is no comparable English work easily accessible to students, diagnostic characters of the families as well as the genera have also been given throughout the text of this paper in addition to those of the species themselves in order to facilitate identification and to afford a broad grasp of the fundamental relationships of the various groups. Working out diagnostic keys based on easily recognizable shell characters alone has not been found practicable in the case of most species of land and freshwater molluscs, since shells differing widely in external appearance may belong to closely allied species and *vice versa* and much of modern systematics of these groups is based upon internal characters. However, in the case of the family Ariophantidae and the genus *Cryptozona* which include numerous important genera and species respectively, and which are well represented in the collection, dichotomous keys have been drawn up, which, although rather artificial, may be helpful in distinguishing broadly between the various forms dealt with in this paper.

In preparing the illustrations for this paper, an attempt has been made to figure specimens of every species recorded in this account. In the case of Gastropod shells both the outer and

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the apertural views have been figured in most instances, and in the case of Lamellibranch shells both the inner and the outer views of the valves have been figured to facilitate identification.

References to literature on land and freshwater molluscs are widely scattered in various volumes of periodicals such as the Journal of the Asiatic Society of Bengal, Proceedings of the Zoological Society of London and Records of the Indian Museum, as well as in standard descriptive works such as the Fauna of British India volumes on Mollusca and the works of Hanley and Theobald, Reeve, Godwin-Austen, Nevill and others. A bibliography including these monographic works as well as a selection of the more important papers in the Records of the Indian Museum and the Journal of the Asiatic Society of Bengal relating specially to South Indian forms is appended at the end of this paper.

I wish to acknowledge my indebtedness to Dr. C. P. Gnanamuthu, Director, Zoological Research Laboratory, Madras University, for his valuable advice and suggestions regarding the methods of systematic study and research in this field, to Dr. H. C. Ray of the Zoological Survey of India for his kind help in connection with the tracing of references to literature for certain species, to Dr. A. Aiyappan, Superintendent, Madras Government Museum, for his encouragement and the facilities he had afforded throughout the progress of this work, to Miss A. Vimala, Assistant Curator for Natural Science in this Museum for her assistance in connection with the preparation of the bibliography for this volume and to Sri S. Kanagasabai, Taxidermist of this Museum for the care and skill with which he has prepared part of the pen and ink illustrations for this volume ; the greater part of the illustrations, however, were drawn by the author himself.

SYSTEMATIC LIST OF THE SPECIES OF LAND AND FRESHWATER MOLLUSCA REPRESENTED IN THE MUSEUM COLLECTION

Class GASTROPODA

Sub-class PROSOBRANCHIA

Order MEGAGASTROPODA

Series ARCHITAENIOGLOSSA

Family Cyclophoridae

Sub-family Cyclophorinae

Genus **Theobaldius** G. Nevill, 1878.

Theobaldius bairdi (Pfeiffer).

Theobaldius ravidus (Benson).

Theobaldius stenostoma (Sowerby).

Genus **Cyclophorus** Montfort, 1810.

Sub-genus **Litostylus** Kobelt & Möllendorff.

Cyclophorus (*Litostylus*) *nilagiricus* (Benson).

Cyclophorus (*Litostylus*) *involvulus* (Müller).

Cyclophorus (*Litostylus*) *ceylanicus* (Pfeiffer).

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Sub-genus **Annularia** Schumacher, 1817.
(=**Salpingophorus** Kobelt & Möllendorff, 1897).
Cyclophorus (*Annularia*) *aurantiacus* (Schumacher).

Genus **Aulopoma** Troschel, 1847.
Aulopoma helicinum (Chemnitz).
Aulopoma itieri (Guérin).
Aulopoma grande (Pfeiffer).

Genus **Pterocyclus** Benson, 1832.
Pterocyclus bilabiatus (Sowerby).
Pterocyclus nanus (Benson).
Pterocyclus comatus Möllendroff.

Genus **Cyathopoma** W & H. Blanford, 1861.
Cyathopoma filocinctum (Benson).

Sub-family Pupininae

Genus **Tortulosa** Gray, 1847.
(=**Cataulus** L. Pfeiffer, 1851).
Tortulosa cumingi (Pfeiffer).
Tortulosa nietneri (Nevill).
Tortulosa pyramidata (Pfeiffer).
Tortulosa recurvatus (Pfeiffer).
Tortulosa templemani (Pfeiffer).

Sub-family Alycaeinae

Genus **Alycaeus** Gray, 1850.
Alycaeus expatriatus Blanford.

Family Viviparidae
Sub-family Viviparinae

Genus **Vivipara** Sowerby, 1813.
Vivipara bangalensis s. str. (Lamarck).
Vivipara bengalensis var. *eburnea* Annandale & Sewell.
Vivipara variata (Frauenfeld).
Vivipara dissimilis (Müller).

Family Ampullariidae

Genus **Pila** (Bolten) Röding, 1798.
Pila globosa (Swainson).
Pila virens (Lamarck).

Series LITTORINACEA

Family Lacunidae

Genus **Mainwaringia** Nevill, 1884.
Mainwaringia paludomoidea (Nevill).

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Family Pomatiasidae
Sub-family Pomatiasinae

Genus **Cyclotopsis** Blanford, 1864.
Cyclotopsis subdiscoidea (Sowerby).

Series RISSOACEA

Family Hydrobiidae (=Paludestrinidae)
Sub-family Bithyniinae

Genus **Bithynia** Leach, 1818.
Bithynia stenothyroides (Dohrn).

Genus **Mysorella** Annandale, 1919.
Mysorella costigera (Kuster).

Family Assimineidae
Sub-family Assimineinae

Genus **Assiminea** (Leach) Fleming, 1828.
Assiminea rubella Blanford.
Assiminea brevicula (Pfeiffer).
Assiminea woodmasoniana Nevill.
Assiminea hungerfordiana Nevill.

Series CERITHIACEA

Family Melaniidae
Sub-family Melanatriinae

Genus **Sulcospira** Troschel, 1857.
Sub-genus **Sulcospira** s. str.
(=**Acrostoma** Brot, 1871, non Le Sauvage, 1826).
Sulcospira (*Sulcospira*) *hugeli* var. *compacta* (Nevill).
Sulcospira (*Sulcospira*) *variabilis* (Benson).

Sub-family Melanopsinae

Genus **Faunus** Montfort, 1810.
Faunus ater (Linné).

Sub-family Paludominae

Genus **Paludomus** Swainson, 1840.
Sub-genus **Paludomus** s. str.
Paludomus monile Hanley.
Paludomus tanschaurica Gmelin.

Sub-genus **Stomatodon** Benson, 1862.
Paludomus (*Stomatodon*) *stomatodon* Benson.

Sub-family Melaniinae

Genus **Melania** Lamarck, 1799.

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Sub-genus **Striatella** Brot, 1871.
Melania (*Striatella*) *tuberculata* (Müller).

Sub-genus **Plotia** (Bolten) Röding, 1798.
Melania (*Plotia*) *scabra* (Müller).
Melania (*Plotia*) *scabra* var. *elegans* Hutton.

Family Cerithiidae
Sub-family Litiopinae

Genus **Litiopa** Rang, 1829
Litiopa kempi Preston.

Sub-class PULMONATA
Order BASOMMATOPHORA
Series HYGROPHILA

Family Lymnaeidae
Sub-family Lymnaeinae

Genus **Lymnaea** Lamarck, 1799.
Lymnaea acuminata Lamarck.
Lymnaea luteola Lamarck.
Lymnaea pinguis Dohrn.
Lymnaea stagnalis Linné.
Lymnaea auricularia (Draparnaud).

Family Planorbidae

Genus **Planorbis** O. F. Müller, 1774.
Sub-genus **Indoplanorbis** Annandale & Prashad, 1920.
Planorbis (*Indoplanorbis*) *exustus* Deshayes.

Genus **Anisus** Studder, 1820.
Sub-genus **Diplodiscus** Westerlund, 1897.
Anisus (*Diplodiscus*) *hyptiocyclos* (Benson).

Sub-genus **Gyraulus** (L. Agassiz) Charpentier, 1837.
Anisus (*Gyraulus*) *convexiusculus* (Hutton).
Anisus (*Gyraulus*) *saigonensis* (Crosse & Fischer).

Order STYLOMMATOPHORA
Series SOLEOLIFERA

Family Vaginulidae

Genus **Vaginulus** Férussac, 1821.
Vaginulus alte Férussac.
Vaginulus frauenfeldi Semper.

Series SUCCINEACEA

Family Succineidae

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Genus **Succinea** Draparnaud, 1801.
Succinea gravelyi Rao.

Series VERTIGINACEA

Family Enidae
Sub-family Eninae

Genus **Ena** (Leach) Turton, 1831.
Sub-genus **Mirus** Albers, 1850.
Ena (*Mirus*) *stalix* (Benson).

Sub-family Napaeinae

Genus **Rachis** Albers, 1850.
(=**Rachisellus** Bourguignat, 1889).
Rachis bengalensis (Lamarck).
Rachis praetermissus (Blanford).
Rachis pulcher (Gray).
Rachis punctatus (Anton).

Genus **Cerastus** (Albers) Martens, 1860.
Cerastus malabaricus (Pfeiffer).
Cerastus jerdoni (Reeve).

Series ACHATINACEA

Family Ferussaciidae

Genus **Glessula** Martens, 1860.
Glessula mullorum (Blanford).
Glessula paupercula (Blanford).
Glessula tornensis (Blanford).
Glessula tenuispira (Benson).
Glessula perrotteti (Pfeiffer).

Family Subulinidae
Sub-family Subulininae

Genus **Subulina** Beck, 1837.
Subulina octona (Bruguière).

Sub-family Opeatinae

Genus **Opeas** Albers, 1850
Opeas gracile (Hutton).
Opeas annandalei Godwin-Austen.

Sub-family Rumininae

Genus **Zootecus** Westerlund, 1887.
Zootecus chion (Pfeiffer).

Family Achatinidae

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Genus **Achatina** Lamarck, 1799.
Achatina fulica (Férussac).

Series ZONITACEA

Family Endodontidae

Sub-family Endodontinae

Genus **Thysanota** Albers, 1860.
Thysanota guérini (Pfeiffer).

Genus **Ruthvenia** Gude, 1911.
Ruthvenia retifera (Pfeiffer).

Family Corillidae

Genus **Corilla** H. & A. Adams, 1855
Corilla adamsi Gude.
Corilla beddomeae (Hanley).
Corilla gudei Sykes.
Corilla fryae Gude.
Corilla erronea Albers.
Corilla carabinata Férussac.

Series ARIOPHANTACEA

Family Ariophantidae

Sub-family Kaliellinae

Genus **Kaliella** Blanford, 1863.
Kaliella barrakporensis (Pfeiffer).

Sub-family Macrochlamydinae

Genus **Macrochlamys** (Benson, 1832) Gray, 1847
Macrochlamys aulopsis (Benson).
Macrochlamys lixa (Blanford).
Macrochlamys woodiana (Pfeiffer).
Macrochlamys vilipensa (Benson).

Sub-family Ariophantinae

Genus **Euplecta** C. Semper, 1870.
Euplecta layardi (Pfeiffer).
Euplecta subdecussata (Pfeiffer).
Euplecta semidecussata (Pfeiffer).
Euplecta travancorica (Benson).
Euplecta indica (Pfeiffer).
Euplecta indica var. *shiplayi* (Pfeiffer).
Euplecta gardeneri (Pfeiffer).
Euplecta acuducta (Benson).
Euplecta hyphasma (Pfeiffer).
Euplecta sp. near *sisparica* (Blanford).

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Genus **Hemiplecta** Albers, 1850.
Hemiplecta basileus (Benson).
Hemiplecta beddomei (Blanford).

Genus **Cryptozona**[1] Mörch, 1872.
Cryptozona ligulata (Férussac).

Sub-genus **Xestina** Pfeffer, 1878.
Cryptozona (*Xestina*) *belangeri* (Deshayes).
Cryptozona (*Xestina*) *albata* (Blanford).
Cryptozona (*Xestina*) *bistrialis* (Beck).

Sub-genus **Nilgiria** Godwin-Austen, 1888.
Cryptozona (*Nilgiria*) *semirugata* (Beck).
Cryptozona (*Nilgiria*) *maderaspatana* (Gray).

Genus **Ariophanta** Desmoulins, 1829.
Ariophanta kadapaensis (Nevill).
Ariophanta thyreus (Benson).
Ariophanta thyreus var. *ryssolemma* (Albers).
Ariophanta cysis (Benson).

Genus **Indrella** Godwin-Austen, 1901.
Indrella ampulla (Benson).

Sub-family Girasiinae

Genus **Mariaella** Gray, 1855.
Mariaella dussumieri Gray.
Mariaella beddomei Godwin-Austen.

Series ACAVACEA

Family Acavidae

Genus **Acavus** Montfort, 1810.
Acavus haemastoma (Linné).
Acavus waltoni (Reeve).
Acavus skinneri (Reeve).

Series HELICACEA

Family Pleurodontidae

Genus **Planispira** Beck, 1837.
Planispira fallaciosa (Férussac).
Planispira vittata (Müller).
Planispira nilagerica (Pfeiffer).

[1] The species of land snails with dextral shells formerly included in the genus *Ariophanta* have now been separated and placed under various genera such as *Hemiplecta*, *Cryptozona*, *Xestina* and *Nilgiria*. Of these, *Xestina* and *Nilgiria* which are of sub-generic status are closely related to *Cryptozona* and are included under the latter generic head by Thiele in his Handbuch der systematischen Weichtierkunde. I have therefore followed Thiele in this paper, in treating these as sub-genera under *Cryptozona* for convenience rather than as separate genera, although Thiele does not expressly designate them as sub-genera. Species with sinistral shells alone are now included in the genus *Ariophanta* Desmoulins.

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Genus **Amphidromus** Albers, 1850.

Sub-genus **Beddomea** Nevill.

Amphidromus (*Beddomea*) *intermedius* (Pfeiffer).

Series STREPTAXACEA

Family Streptaxidae

Genus **Streptaxis** Gray, 1837.

Streptaxis peroteti (Petit).

Genus **Ptychotrema** (Mörch) L. Pfeiffer, 1853.

Sub-genus **Ennea** H. & A. Adams, 1855.

Ptychotrema (*Ennea*) *bicolor* (Hutton).

Ptychotrema (*Ennea*) *bicolor* race *barkudensis* (Annandale & Prashad).

Ptychotrema (*Ennea*) *subcostulata* (Blanford).

Class PELECYPODA

Order EULAMELLIBRANCHIATA

Sub-order SCHIZODONTA

Series UNIONACEA

Family Unionidae

Sub-family Unioninae

Genus **Parreysia** Conard, 1853.

Sub-genus **Parreysia** s. str.

Parreysia (*Parreysia*) *corrugata* var. *nagpoorensis* (Lea).

Parreysia (*Parreysia*) *wynegungaënsis* (Lea).

Genus **Lamellidens** Simpson, 1900.

Lamellidens marginalis (Lamarck).

Lamellidens corrianus (Lea)

Sub-order HETERODONTA

Series SPHAERIACEA

Family Corbiculidae

Sub-family Corbiculinae

Genus **Villorita** Griffith & Pidgeon, 1834.

Villorita cyprinoides (Gray).

Villorita cyprinoides var. *cochinensis* (Hanley).

Genus **Corbicula** Megerle von Mühlfeld, 1811.

Corbicula striatella Deshayes.

Corbicula occidens Deshayes.

Corbicula regularis Prime.

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DESCRIPTIONS OF THE SPECIES

Class GASTROPODA

Sub-class PROSOBRANCHIA

Order MEGAGASTROPODA

Series ARCHITAENIOGLOSSA

Family CYCLOPHORIDAE

The shell is very variable in form and size, ranging from a depressed disc-like shape to an elongated tower-shaped form, but mostly globularly top-shaped, either dextral or sinistral, sometimes with loosely wound whorls. The outer surface of the shell is either smooth or sculptured. The aperture is circular and the peristome either continuous or divided, sometimes with a notch. The operculum is almost circular, horny or calcareous, with considerably close-set spirals, and sometimes with an external projection. The animals, in which the pallial cavity is modified into a lung, are terrestrial.

Sub-family CYCLOPHORINAE

The shell ranges in size from small to moderately large, and is variously shaped, discoidal to top-shaped. The operculum is horny or calcareous and closely spirally coiled.

Genus **Theobaldius** G. Nevill, 1878

The shell is depressed or discoidal, widely umbilicated. The last whorl is rounded and the aperture is circular. The peristome is usually double. The operculum is thin and horny, composed of many whorls.

Theobaldius bairdi (Pfeiffer)

Plate I, figs. 1a and 1b

Cyclostoma bairdi (*Cyclophorus*), Pfeiffer, Proc. Zool. Soc. London, 1852, p. 144, pl. 13, fig. 1.
Cyclophorus bairdi, Adams, Genera of Recent Mollusca, II, 1855, p. 279.
Cyclophorus bairdi, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 15, fig. 68.
Cyclophorus bairdi, Hanley & Theobald, Conch. Indica, 1870, pl. 4, fig. 1.
Cyclophorus bairdi, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 303.
Myxostoma bairdi, Theobald, Cat. Shells Brit. India, 1876, p. 36.
Cyclophorus (*Theobaldius*) *bairdi*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 275.
Theobaldius bairdi, Kobelt and Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 88.
Theobaldius bairdi, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 32.

The shell is widely umbilicated, depressed, almost discoidal, the whorls of the spire being nearly on the same level as the body whorl. The surface of the shell is finely spirally striated throughout, but the upper whorls of the spire are traversed by fine, oblique transpiral striae.

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The sutures are well impressed. The aperture is oblique and circular, but feebly angulated on the inner border. The peristome is continuous and slightly thickened and reflected out. The shell is chestnut-brown, ornamented with distinct, wavy, transpiral, pale yellowish brown bands which tend to take a rather sharply angular and zig-zag course on the body whorl, especially towards the aperture. The lower surface of the body whorl is creamy white and devoid of colour markings. The interior of the aperture is white, and the umbilicus very wide and open.

Recorded localities : Kandy, Badulla, Maturata, Ceylon.

Specimens in the collection : A single shell from Watawala, Ceylon. The operculum is missing. Its dimensions are as follows : Diameter, major : 23 mm. ; minor : 18 mm. ; height : 8 mm. These are only slightly less than the typical measurements cited by Pfeiffer. Fine, oblique, transpiral ridges are clearly seen with a lens in the uppermost whorls of the spire in this specimen.

Theobaldius ravidus (Benson)

Plate I, figs. 2*a* and 2*b*

Cyclostoma ravidum, Benson, Ann. and Mag. Nat. Hist., ser. 2, VIII, 1851, p. 190.
Cyclophorus ravidus, Pfeiffer, Zeits. Malak., VIII, 1851, p. 144.
Cyclophorus ravidus, Benson, Ann. & Mag. Nat. Hist., ser. 2, XIV, 1854, p. 415.
Cyclophorus ravidus, Adams, Genera of Recent Mollusca, II, 1855, p. 280.
Cyclophorus ravidus, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 20, fig. 102.
Cyclophorus ravidus, Blanford, Journ. Asiatic Soc. Bengal, XXXVIII, 1869, p. 143.
Cyclophorus ravidus, Hanley & Theobald, Conch. Indica, 1875, p. 42, pl. 105, figs. 5 and 6.
Myxostoma ravidum, Theobald, Cat. Shells Brit. India, 1876, p. 37.
Cyclophorus (*Theobaldius*) *ravidus*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 276.
Theobaldius ravidus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 41.

The shell is widely umbilicated and subdiscoidal, the spire being only slightly, though distinctly elevated. The surface is finely transpirally striated, and covered with a thin olive-brown periostracum, below which the surface of the shell is white. The sutures are sunk. The apex is obtuse. The aperture is circular, its edge being oblique. The operculum is thin, horny, many-whorled and externally concave.

Recorded localities : Nilgiris, Kolamullay, Anamalai Hills, Wynaad, Battingh, Bettampatti and Shevroy Hills. The species attains a much larger size in the Anamalai Hills and Wynaad than the type, and Nevill has separated these two forms as var. *anamullayensis* and var. *wynaadensis* respectively.

Specimens in the collection : A single shell from Thirupathi Hills, Chittoor District, identified by Dr. Biani Prashad. The operculum is missing. There is a pale brownish spiral band on the body whorl just below the middle. Its measurements are as follows : Diameter, major : 18 mm. ; minor : 16 mm. ; axis : 10 mm. Judging from its size, it appears larger than the type

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and is intermediate between the typical form and the larger hill varieties mentioned above, which attain a maximum diameter of over 24 mm.

Theobaldius stenostoma (Sowerby)

Plate I, figs. 3*a* and 3*b*

Cyclostoma stenostomus, Sowerby, Thes. Conchyl., I, 1843, p. 95, pl. 31, fig. 261.
Cyclostoma stenostoma, Pfeiffer, Conch. Cab., Cyclostomaceen, 1849, p. 149, pl. 20, figs. 23–25.
Cyclophorus stenostoma, Pfeiffer, Zeits. Malak., IV, 1847, p. 108.
Cyclophorus stenostoma, Benson, Ann. & Mag. Nat. Hist., ser. 2, XIV, 1854, p. 415.
Cyclophorus stenostomus, Adams, Genera of Recent Mollusca, II, 1855, p. 280.
Cyclophorus stenostoma, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 17, fig. 82.
Cyclophorus stenostoma, Hanley & Theobald, Conch. Indica, 1875, p. 42, pl. 105, figs. 7 and 8.
Myxostoma stenostoma, Theobald, Cat. Shells Brit. India, 1876, p. 37.
Cyclophorus (*Theobaldius*) *stenostoma*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 276.
Theobaldius stenostomus, Kobelt & Möllendorff, Deuts. Malak. Ges., XXIX, 1897, p. 105.
Theobaldius stenostoma, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 42.

The shell is depressed and more or less discoidal and suborbicular. The surface is finely and closely transpirally striated. The umbilicus is broad, open and deep. The spire is almost horizontally flattened, the whorls being narrow and slightly depressed below the sutures. The aperture is small, strongly oblique, almost circular and angulated posteriorly. The peristome is only slightly thickened. The operculum is horny, pale brownish, with six whorls. The shell is chestnut-brown, with numerous white, zig-zag, flame-like markings.

Recorded localities : Nilgiris, Ootacamund. Hanley and Theobald recorded a variety from the top of the Nilgiris, namely, var. *anguis* distinguished by raised, concentric, wavy wrinkles, which might possibly be a distinct species.

Specimens in the collection : Three shells from the Nilgiris, two of them with the operculum intact. The lower surface in these shells is almost whitish, the markings being indistinct. The upper whorls in one of these is purplish brown. The dimensions of the largest of these are as follows : Diameter, major : 17 mm. ; minor : 14 mm. axis : 8 mm. ; aperture : 5 mm. wide. The other two shells are only slightly smaller.

Genus **Cyclophorus** Montfort, 1810

The shell is globosely top-shaped, or more or less depressed or even discoidal. The peristome is continuous, expanded or straight. The operculum is thin, horny, closely coiled and externally smooth and concave, without raised edges to the whorls.

Sub-genus **Litostylus** Kobelt & Möllendorff, 1897

The shell is more or less depressed, ribbed or spirally striated and the peristome is not appreciably dilated.

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Cyclophorus (Litostylus) nilagiricus (Benson)

Plate I, figs. 4*a* to 4*c*

Cyclostoma nilagiricum, Benson, Ann. & Mag. Nat. Hist., ser. 2, X, 1852, p. 268.
Cyclophorus nilagiricus, Benson, Ann. & Mag. Nat. Hist., ser. 2, XIV, 1854, p. 415.
Cyclophorus nilagiricus, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 2, fig. 6.
Cyclophorus nilagiricus, Hanley & Theobald, Conch. Indica, 1870, pl. 1, fig. 5.
Cyclophorus nilgiricus, Theobald, Cat. Shells Brit. India, 1876, p. 36.
Cyclophorus niligiricus, Theobald, Journ. Asiatic Soc. Bengal, XLV, 1876, pt. 2, p. 185.
Cyclophorus nilagiricus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 269 (& var. *minor*).
Cyclophorus (Litostylus) nilagiricus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 105.
Cyclostoma (Cyclophorus) pirrieanum, Pfeiffer, Proc. Zool. Soc. London, 1853, p. 51.
Cyclophorus pirrieanus, Adams, Genera of Recent Mollusca, II, 1855, p. 280.
Cyclophorus (Litostylus) nilagiricus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 51.

The shell is solid, depressedly turbinate and umbilicated, the umbilicus being moderately deep and subcylindrical. The whorls are finely spirally ridged, and immediately below the sutures they are horizontally flattened and even somewhat concavely depressed. The body whorl bears a strong keel along the middle, but this is not so strongly marked in young shells. The aperture is oblique and almost circular, with the peristome strongly reflected outwards. The operculum is thin, horny and externally concave with closely wound whorls. The shell is deep chestnut-brown, marked with yellowish white streaks which are transpirally elongated on the broad, flattened upper part of the body whorl and the preceding whorls, but irregularly broken up below the shoulder of the body whorl. The keel on the body whorl is marked with alternate chestnut and white spots. The colour is much deeper beneath the keel. The operculum is horny brown and the peristome bright reddish orange.

Recorded localities : Nilgiris, Travancore, Walaghat, Koondah Hills, South Canara, Balarangam.

Specimens in the collection : Three shells, one adult and two young.

(i) Adult shell : The colour is fairly fresh and typical of the species, but the peristome is faded almost into pure white, and the region surrounding the umbilicus is also whitish. The operculum is intact. Measurements : Diameter, major : 44 mm. ; minor : 36 mm. ; axis : 23 mm. Locality : Mudgiri, Mysore.

(ii) Young shells : These are rather worn. The shoulder and the keel on the body whorl are scarcely distinguishable. The spiral striation on the whorls, however, are well marked. Compared to the adult, the whorls above the body whorl are correspondingly more inflated and elevated. The bigger of the two shells is almost completely worn and faded into a dirty white, but the younger shell retains the dark chestnut brown and transpiral white markings. The operculum is missing in both these shells. Measurements : (i) Diameter, major : 32 mm. ; minor : 24 mm. ; axis : 17 mm. (ii) Diameter, major : 27 mm. ; minor : 21 mm. ; axis : 13 mm. Locality : Sudikonda, Godavary District.

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Cyclophorus (Litostylus) involvulus (Müller)

Plate I, figs. 5*a* to 5*c*

Helix involvulus, Müller, Hist. Verm., part 2, 1774, p. 84.
Cyclostoma involvulus, Benson, Journ. Asiatic Soc. Bengal, V, 1836, p. 355.
Cyclostoma involvulus, Sowerby, Thes. Conchyl., I, 1843, p. 119, pl. 26, figs. 114–116.
Cyclophorus involvulus, Pfeiffer, Zeits. Malak., IV, 1847, p. 108 ; VIII, 1851, p. 138.
Cyclophorus involvulus, Adams, Genera of Recent Mollusca, II, 1855, p. 280.
Cyclophorus involvulus, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 1, fig. 1.
Cyclophorus involvulus, Hanley & Theobald, Conch. Indica, 1876, pl. 2, fig. 1.
Cyclophorus involvulus, Theobald, Cat. Shells Brit. India, 1876, p. 36.
Cyclophorus involvulus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 273.
Cyclophorus involvulus, Fischer, Man. de Conchyl., 1855, p. 744, pl. 12, fig. 41.
Cyclophorus (Litostylus) involvulus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 105.
Cyclophorus (Litostylus) involvulus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 47.

The shell is turbinated with comparatively more strongly inflated whorls and more elevated spire than in *C. (Litostylus) nilagiricus*. The umbilicus is fairly wide and deep, its opening being partly occluded by the reflected peristome. There is no keel on the body whorl, but the shell is finely spirally striated, a few of the striae on the body whorl being stronger and taking the form of widely spaced, feebly raised spiral ridges. The aperture is circular and oblique, its interior being smooth and glossy and tinged with orange-red towards the periphery. The peristome is thickened, but much less markedly reflected than in the preceding species. The shell is chestnut-coloured, marbled with pale brownish white zig-zag markings. The interior of the aperture is glossy white, tinged with orange red towards the periphery. The operculum is normal.

Recorded localities : India : Bihar, Sylhet ; Ceylon : Point de Galle. Its distribution is rather discontinuous, being unknown in Central and Southern India, but represented in Ceylon.

Specimens in the collection : Two specimens, a large, adult shell with the operculum missing, and a young shell with the operculum intact. (i) Adult shell : Measurements : Diameter, major : 40 mm. ; minor : 33 mm. ; axis : 24 mm. Compared with the type measurements cited by Gude (Diameter, major : 34 mm. ; minor : 28 mm. and axis : 20 mm.) the present specimen appears to be considerably large. The maximum internal diameter of the aperture is 17 mm. as against 14 mm. quoted by Gude. Locality : Midnapur.

(ii) Young shell : Measurements : Diameter, major : 31 mm.; minor : 26 mm. ; axis : 15 mm. The peristomial thickening is more marked than in the adult shell. The operculum is horny brown, externally concave, 11 mm. in diameter. The dimensions are only slightly smaller than those of a typical full-grown shell. Locality : Negombo, Ceylon.

This species is popularly known as the Cankerworm *Cyclophorus*.

Cyclophorus (Litostylus) ceylanicus (Pfeiffer)

Plate I, figs. 6*a* to 6*d*

Cyclostoma ceylanicum (Sowerby MS) Pfeiffer, Conch. Cab., Cyclostomaceen, 1849, p. 171, pl. 29, figs. 1–3.
Cyclostoma indicum, Sowerby, Thes. Conchyl., II, 1850, p. 163, pl. 31*b*, figs. 320 and 321 (non Deshayes).
Cyclophorus ceylanicus, Adams, Genera of Recent Mollusca, II, 1855, p. 272.
Cyclophorus ceylanicus, Hanley & Theobald, Conch. Indica, 1876, pl. 33, fig. 2.
Cyclophorus ceylanicus, Theobald, Cat. Shells Brit. India, 1876, p. 35.
Cyclophorus ceylanicus, Nevill, Hand List, Moll. Ind. Mus., I, 1878, p. 272.
Cyclophorus menkeanus, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 10, fig. 42 (non Philippi).
Cyclophorus (Litostylus) ceylanicus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 105.
Cyclophorus (Litostylus) ceylanicus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 46.

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The shell is fairly thick and solid, with a moderately wide and deep umbilicus, and more or less depressedly turbinated. The umbilicus is partly occluded by the reflected peristome. The body whorl bears a distinct spiral keel along the middle. The sculpture consists of fairly strong and evenly spaced spiral ridges and fine transpiral striae. The ridges are distinctly grooved and thus rendered double, this condition being most marked on the body whorl above the keel. Below the keel, the spiral ridges are reduced to weak striae, but the fine, close-set transpiral striation is well marked in this region. The part of the whorls immediately below the sutures is rather flattened. The aperture is oblique and almost circular, with the peristome thickened, but only slightly reflected. The operculum is horny and externally concave. The shell is dark chestnut- or purplish brown, with somewhat obscure, irregular, wavy transpiral pale brown markings which are more distinctly seen on the whorl above the body whorl. The part of the body whorl below the keel is paler brown, characteristically marked with dark coloured spiral bands. The interior of the aperture is smooth and glossy white.

Recorded localities : Ceylon ; Kandy, Ceylon.

Specimens in the collection : A single shell, with the operculum intact, from Nawalapitiya, Ceylon. Measurements : Diameter, major : 33 mm. ; minor : 26 mm. ; axis : 19 mm. Maximum diameter of the operculum : 13 mm. The specimen does not appear to be a full-grown shell, these measurements being considerably smaller than those of the typical adult shell. The spiral whorls on the operculum are well marked.

Sub-genus **Annularia** Schumacher, 1817

(Syn. **Salpingophorus** Kobelt & Möllendorff, 1897)

The whorls of the shell rapidly increase in size from above downwards, the body whorl being expanded in front and the peristome thickened and reflected.

Cyclophorus (**Annularia**) **aurantiacus** (Schumacher).

Plate II, figs. 1*a* to 1*c*

Turbo volvulus, Chemnitz, Conch. Cab., IX, sect. 2, 1786, p. 57, pl. 123, figs. 1064 and 1065.
Annularia aurantiacum, Schumacher, Essai Nouv. Syst. Vers. Test., 1817, p. 196.
Cyclostoma aurantiacum, Pfeiffer, Zeits. Malak., III, 1846, p. 33 ; Conch. Cab., Cyclostomaceen, 1847, p. 31, pl. 4, figs. 8 and 9.
Cyclophorus aurantiacus, Theobald, Journ. Asiatic Soc. Bengal, XXVI, 1857, p. 245.
Cyclophorus aurantiacus, Reeve, Conch. Icon., XIII, 1861, *Cyclophorus*, pl. 1, fig. 3.
Cyclophorus aurantiacus, Blanford, Journ. Asiatic Soc. Bengal, XXXIV, 1865, p. 96.
Cyclophorus aurantiacus, Mörch, Journ. de Conchyl., XX, 1872, p. 338.
Cyclophorus aurantiacus, Hanley & Theobald, Conchologia Indica, 1876, p. 16, pl. 33, fig. 4.
Cyclophorus aurantiacus, Theobald, Cat. Shells Brit. India, 1876, p. 35.
Cyclophorus aurantiacus, Nevill, Hand List, Moll. Ind. Mus., I, 1878, p. 266.
Cyclophorus (*Salpingophorus*) *aurantiacus*, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 109.
Cyclophorus malayanus (non Benson), de Morgan, Bull. Soc. Zool. France, X, 1885, p. 410.
Cyclophorus (*Salpingophorus*) *aurantiacus*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 71.

The shell is large, being much larger than those of the preceding species, rather depressedly turbinate, thick, solid and very widely and deeply umbilicated. The spire is somewhat broad

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and short, the whorls being depressedly convex and increasing in size rapidly from above downwards. The body whorl is very large, broad and somewhat depressed and expanded in front towards the aperture. The surface of the whorls is spirally striated over their upper parts. Fine, close-set, transpiral striae are also present, these being particularly conspicuous on the basal surface of the body whorl around the umbilicus. The aperture is very large, almost circular, suboblique, with a continuous peristome which is conspicuously thickened and reflected out. The umbilicus is large and deeply excavated. The operculum is horny and spirally whorled. The shell is straw-yellow or fulvous white, heavily blotched and freckled with irregularly zigzagging transpiral reddish brown markings. The body whorl bears a broad, dark chestnut-brown spiral band just below the periphery. This band is bordered above by a pale yellowish brown spiral zone which in turn is ornamented with a series of narrow, dark brown spiral bands. The region surrounding the umbilicus on the basal surface of the body whorl is pale fulvous white traversed by a few irregularly spaced brownish spiral bands. The inner surface of the apertural lip is bright orange and the interior of the aperture whitish.

Recorded localities : Burma, Tongoop, Arakan and Ramri Island ; Pegu ; Zwagabin, near Moulmein, Tenasserim ; Tranquebar, India. Malay Peninsula : Perak.

Specimens in the collection : A single large shell with the colour and markings beautifully fresh, received from the Madras Christian College collection. Unfortunately its exact locality is not known. Measurements : Diameter, major : 66 mm. ; minor : 56 mm. ; height : 38 mm. ; Aperture ; internal diameter : 32 mm. ; internal height : 29 mm. These measurements are considerably larger than those of the type quoted by Gude (*loc. cit.*).

Genus **Aulopoma** Troschel, 1847

The shell is depressedly turbinated or discoidal. The body whorl is solute (*i.e.*, more or less tubular and distinctly separated from the rest of the shell towards its terminal part). The peristome is thin, free, and continuous and fits into a circular groove on the inner surface of the operculum, which is slightly larger than the aperture. The operculum in this genus is peculiar in that it is composed of two laminae, closely apposed, with a spiral cavity in between. This genus has a very restricted distribution, being represented only in Ceylon.

Aulopoma helicinum (Chemnitz)

Plate II, figs. 2*a* to 2*c*

Turbo helicinus, Chemnitz, Conch. Cab., IX, part 2, 1786, p. 59, pl. 123, figs. 1067 and 1068.
Cyclostoma helicinum, Pfeiffer, Conch. Cab., Cyclostomaceen, 1849, p. 160, pl. 22, figs. 4 and 5.
Aulopoma helicinum, Gray, Nomencl. Moll. Brit. Mus., 1850, p. 14.
Aulopoma helicinum, Adams, Genera of Recent Mollusca, II, 1855, p. 283.
Aulopoma helicinum, Hanley & Theobald, Conch. Indica, 1876, pl. 4, fig. 8.
Aulopoma helicinum, Theobald, Cat. Shells Brit. India, 1876, p. 37.
Aulopoma helicinum, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 279.
Aulopoma helicinum, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 302.
Aulopoma helicinum, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 95.

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The shell is subdiscoidal, widely umbilicated, with the small upper whorls of the spire slightly but sharply and abruptly elevated above the general surface level. The whorls are moderately inflated and rounded and the sutures appear as strongly impressed spiral grooves. The surface of the shell is finely and closely transpirally striated throughout. The body whorl descends slightly downwards towards its free end, where it is distinct from the rest of the shell. The aperture is oblique and almost perfectly circular in outline. The peristome is straight, continuous, thin and sharp. The operculum is horny, internally concave and strongly spirally whorled, the whorls being convexly raised and externally traversed by strong, obliquely transpiral ridges or folds. The shell is rufous brown with irregular, pale straw-coloured zig-zag markings all over, but towards the apex it is purplish brown.

Recorded localities : Ceylon ; Balapiti, Ceylon.

Specimens in the collection : One shell, with the operculum intact from Gampola, Ceylon. A more or less distinct brownish spiral band is seen along the middle of the body whorl, below which the shell is pale horny brown, devoid of markings. Measurements : Diameter, major : 17 mm. ; minor : 14 mm. ; axis : 8 mm. ; maximum diameter of operculum : 8 mm.

The narrow groove on the margin of the operculum into which the edge of the peristome fits is clearly seen as a deep channel all round in the present specimen. The measurements are considerably larger than the type measurements quoted by Gude (*loc. cit.*).

Aulopoma itieri (Guérin)

Plate II, figs. 3*a* and 3*b*

Cornu venatorium, Chemnitz, Conch. Cab., IX, part 2, 1786, p. 104, pl. 127, figs. 1132 and 1133.
Cyclostoma itieri, Guérin, Rev. Zool., X, 1847, p. 2.
Aulopoma cornu-venatorium, Adams, Genera of Recent Mollusca, II, 1855, p. 283, pl. 85, fig. 8 (shell) ; figs. 8*a* and 8*b* (operculum).
Aulopoma itieri, Pfeiffer, Zeits. Malak., IV, 1847, p. 111.
Aulopoma itieri, Gray, Nomencl. Moll. Brit. Mus., 1850, p. 14.
Aulopoma itieri, Adams, Genera of Recent Mollusca, II, 1855, p. 283.
Aulopoma itieri, Hanley & Theobald, Conch. Indica, 1876, pl. 4, fig. 7, var. fig. 6.
Aulopoma itieri, Theobald, Cat. Shells Brit. India, 1876, p. 37.
Aulopoma itieri, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 279.
Aulopoma itieri, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 96.

The shell is much larger than in the preceding species, sub-orbicular, horizontally depressed above, the whorls of the spire being almost on a level with the body whorl, only the minute apical part of the spire being slightly and abruptly exserted above the general surface level of the shell. The free terminal part of the body whorl is inclined downwards and appears as though slightly detached from the rest of the shell. The sutures are deeply impressed and the umbilicus is widely open and deep. The operculum is horny, thin, spirally whorled and externally placed, and slightly exceeds the diameter of the aperture, the margin of which fits into a narrow channel in the border of the operculum. Guérin, the French conchologist, in his original description, states that, so far as he knew, this was the first instance of an operculum being external, and the

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margin of which overlapped the border of the aperture. The surface of the shell is finely and closely transpirally striated throughout. The shell is pale horny brown, ornamented with rufous brown, irregular or arrow-head-shaped markings. A distinct dark brown spiral band runs along the middle of the body whorl ; below this band the markings are absent.

Recorded localities : Ceylon ; Kandy, Ceylon ; West Province, Ceylon.

Specimens in the collection : One shell, with the operculum missing, from Kegalle, Ceylon. Measurements : Diameter, major : 24 mm. ; minor : 20 mm. ; axis : 11 mm. ; diameter of aperture : 9 mm.

The major and minor diameters of this shell are slightly more than the type measurements, but the height of the shell is the same as that of the type, quoted by Gude. The periostracum has peeled away in a small portion of the surface, exposing the glossy white colour of the inner layer.

Aulopoma grande (Pfeiffer)

Plate II, figs. 4*a* to 4*c*

Cyclostoma (*Aulopoma*) *grande*, Pfeiffer, Proc. Zool. Soc. London, 1855, p. 104.
Aulopoma grande, Hanley & Theobald, Conch. Indica, 1876, pl. 47, figs. 1 and 2.
Aulopoma grande, Theobald, Cat. Shells Brit. India, 1876, p. 37.
Aulopoma grande, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 279.
Aulopoma grande, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 113.
Aulopoma grande, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 95.

Of the three species of *Aulopoma* reported in this paper, the present species has the largest shell. The whorls are more strongly inflated and the whorls of the spire are less strongly depressed than in the two preceding species. The shell is solid, and widely and deeply umbilicated, with the surface finely and closely transpirally striated throughout. The spire is short and broadly conical and acuminated. The body whorl is inclined downwards towards its free terminal part where it is distinct and well separated from the rest of the shell. The aperture is oblique and sub-circular, with the peristome simple, thin and straight, fitting into a groove on the margin of the operculum. The operculum is thick, closely spirally whorled and characteristically composed of a double lamina enclosing a spiral space between. The whorls of the operculum are externally traversed by strong, obliquely transpiral ridges. The shell is pale straw-coloured, marbled with darker brownish markings, with a well marked, dark brown spiral band along the middle of the body whorl. The upper whorls of the spire are dark purplish brown.

Recorded localities : Ceylon ; Matelle East, Ceylon.

Specimens in the collection : A single shell, with the operculum intact, from Matelle, Ceylon. Measurements : Diameter, major : 27 mm. ; minor : 23 mm. ; axis : 15 mm. ; maximum diameter of operculum : 13 mm. These are larger than the type measurements cited by Gude (*loc. cit.*). The operculum is slightly damaged, but the deep, channel-like groove for the reception of the peristome is clearly seen.

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Genus **Pterocyclus** Benson, 1832

(Syn. **Spiraculum** (part) Pearson, 1833 ;

Steganotoma Troschel, 1837)

The shell is depressed and discoidal, somewhat convex above and concave below, widely umbilicated. The peristome is usually reflected, divided by an oblique notch at the upper end of the aperture. The outer lip bears an arched wing at the upper part. The operculum is multi-whorled and externally convex, the edges of the whorls being slightly raised.

Pterocyclus bilabiatus (Sowerby)

Plate II, figs. 5*a* and 5*b*

Cyclostoma bilabiatum, Sowerby, Thes. Conchyl., I, 1843, p. 110, pl. 25, figs. 81 and 82.
Pterocyclos bilabiatus, Benson, Zool. Journ., V, 1835, p. 462.
Pterocyclos bilabiatus, Pfeiffer, Zeits. Malak., IV, 1847, p. 111.
Pterocyclos bilabiatus, Benson, Ann. & Mag. Nat. Hist., ser. 2, I, 1848, p. 346.
Pterocyclos bilabiatus, Adams, Genera of Recent Mollusca, II, 1855, p. 277.
Pterocyclos bilabiatus, Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, pp. 363 and 364.
Pterocyclos bilabiatus, Reeve, Conch. Icon., XIV, 1863, *Pterocyclos*, pl. 3, fig. 13.
Pterocyclos bilabiatus, Hanley & Theobald, Conch. Indica, 1876, p. 3, pl. 5, fig. 2.
Pterocyclos bilabiatus, Theobald, Cat. Shells Brit. India, 1876, p. 38.
Pterocyclus bilabiatus, Nevill, Hand List Moll. Ind. Mus. I, 1878, p. 262.
Pterocyclus bilabiatus, Kobelt & Möllendorff, Nachr. Deuts. M Malak. Ges., XXIX, 1897, p. 113.
Pterocyclus bilabiatus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 100.

The shell is depressed and discoidal with an almost completely flattened spire. The whorls are rounded, five in number, and separated by distinct, rather deep sutures. The aperture is nearly circular and oblique, with the edge of the peristome characteristically divided into an inner and outer lip, a feature implied by the specific name of this species. The inner lip is simple and bears a deep notch at its upper part, while the outer lip is strongly undulated and sinuous, terminating in a swollen vault-like tubercle at its upper part, over the sinus of the inner lip. The umbilicus is large, widely open and spreading, the spiral coiling of the under surface of the whorls being distinctly seen within the umbilicus. The operculum is horny brown, circular, spirally whorled, concave within, and convex and strongly concentrically lamellated externally. The surface of the shell is smooth, whitish or pale straw-coloured, ornamented with undulating reddish brown transpiral markings.

Recorded localities : Salem, Madras ; Kolamullay Hills and Nilgiris ; Coonoor Pass ; Hills of South India (Theobald) ; Behar (Hanley & Theobald).

Specimens in the collection : Two shells with their opercula intact, but one of them slightly worn and with the apex of its spire wanting, from Salem, Madras State. Both shells are of almost the same size. The measurements of the larger shell are as follows : Diameter, major : 15 mm. ; minor : 12 mm. ; axis : 7 mm. The specimens appear to be young, these measurements being considerably smaller than the type measurements cited by Gude (*loc. cit.*). The spire is purplish brown towards its apical part in the fresher of the two shells. The operculum is very convex externally, with very strongly raised concentric lamellae.

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Pterocyclus nanus (Benson)

Plate II, figs. 6*a* and 6*b*

Pterocyclos nanus, Benson, Ann. & Mag. Nat. Hist., ser. 2, VIII, 1851, p. 450.
Pterocyclos nanus, Pfeiffer, Conch. Cab., Cyclostomaceen, 1854, p. 388, pl. 49, figs. 31–33.
Pterocyclos nanus, Adams, Genera of Recent Mollusca, II, 1855, p. 277.
Pterocyclos nanus, Reeve, Conch. Icon., XIV, 1863, *Pterocyclos*, pl. 3, fig. 12.
Pterocyclos nanus, Blanford, Journ. Asiatic Soc. Bengal, XXXV, 1866, pp. 38 and 40.
Pterocyclos nanus, Hanley & Theobald, Conch. Indica, 1876, p. 23, pl. 49, figs. 5 and 6.
Pterocyclos nanus, Theobald, Cat. Shells Brit. India, 1876, p. 38.
Pterocyclus nanus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 262.
Pterocyclus nanus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 100.

The shell is depressed, sub-discoidal, deeply and openly umbilicated. The whorls are narrow and rounded with very fine, obliquely transpiral striations on the surface. The aperture is oblique and circular, and the peristome is expanded into a thin, wing-like dilatation which is sinuously swollen and bent forwards, overhanging the characteristic incision in the lip at this part. In his original account of this species, Benson remarks that the " operculum is unknown ", and Gude also has not referred to any operculum in his volume on Mollusca in the Fauna of British India Series (*loc. cit.*), but in all the three specimens represented in the Museum collection, the operculum is present and intact. It is horny brown, thick, convex externally and bears about six very strongly raised crest-like concentric lamellae with very deeply excavated interstices between them. The shell is whitish, irregularly streaked and blotched all over with reddish brown markings. On the body whorl and the lower part of the spire these markings are more or less transpirally disposed, but they break up into irregular patches towards the spire. The lower surface of the shell is whitish, but is broadly banded with pale brown immediately surrounding the umbilicus.

Recorded localities : Nilgiris, Anamalais ; Southern India, Salem.

Specimens in the collection : Three shells, all with the operculum intact. Average measurements : Diameter, major : 16 mm. ; minor : 14 mm. ; axis : 9 mm. ; diameter of operculum : 5 mm. As the dimensions of these specimens are considerably larger than the type measurements quoted by Gude (*loc. cit.*), it is possible that the type specimens examined by Benson were probably not full grown ones. Locality : Mudgiri, Mysore, whence this species does not appear to have been recorded previously.

Pterocyclus comatus Möllendorff

Plate II, figs. 7*a* and 7*b*

Pterocyclus comatus, (Beddome), G. Nevill, Journ. Asiatic Soc. Bengal, I, 1881, p. 146.
Pterocyclus comitis, (Beddome), Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 36.
Pterocyclus comitis, Kobelt & Möllendorff, *tom. cit.*, p. 113 ; id., Cat. Pneum., 1899, p. 25.
Pterocyclus comatus, Kobelt, Conch. Cab., Cyclophoridae, II, 1910, p. 748, pl. 109, figs. 6–8.
Pterocyclus comatus, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 102.

The shell is depressed, almost completely discoidal, solid, and widely and openly umbilicated. The surface is traversed by fine, close-set, plicated striae. The sutures are deeply sunk in channel-like grooves. The perspective coiling of the whorls is clearly seen on the under surface through

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the open umbilicus. The aperture is circular and oblique. The peristome is slightly thickened and rendered characteristically double, the internal lip being deeply notched above. The external lip is dilated into a wing-like expansion above, which terminates as a tumid, tubercle-like swelling overhanging the incision of the inner lip. No mention is made of the operculum in the previous accounts of this species, but in all the three specimens examined the operculum is intact. It is dark horny brown, externally convex and strongly spirally whorled, bearing about seven strongly raised concentric lamellae which, however, are much more closely set than in the operculum of the preceding species. The shell is whitish or pale straw-coloured, marked with flame-like reddish brown transpiral bands. There is a more or less distinct, though somewhat broken, dark brown spiral band running along the middle of the body whorl below which the surface is glossy whitish and comparatively devoid of colour markings.

Recorded localities : Anamalai Hills.

Specimens in the collection : Three small shells, all of them with the operculum intact, but one with the margin of the apertural lip broken. The apical part and upper whorls of the spire in these shells are somewhat dark purplish brown. Average measurements : Diameter, major : 14 mm. ; minor : 12 mm. ; axis : 7 mm. ; diameter of operculum : 4 mm. The dimensions of these specimens are slightly less than the type measurements cited by Möllendorff. Locality : Tirupathi Hills, Chittoor District and Sudikonda, Godavari District. These shells were collected by Prof. R. V. Seshiya and were later identified for us by Dr. Baini Prashad.

Genus **Cyathopoma** W. & H. Blanford, 1861

The shell is small, umbilicated, top-shaped or depressedly turbinated, usually with spiral striae and with a thick periostracum. The operculum is internally convex, multispirally whorled, and composed of two laminae, the inner horny and membranaceous and the outer calcareous and strongly concave, the edges of the whorls being free, but occasionally raised and ornamented.

The type of this genus is *Cyclotus filocinctus*, which is the only species of this genus represented in the collections in this Museum. It is now referred to as *Cyathopoma filocinctum*.

Cyathopoma filocinctum (Benson)

Plate II, fig. 8

Cyclostoma filocinctum, Benson, Ann. & Mag. Nat. Hist., ser. 2, VIII, 1851, p. 188.
Cyclostoma filocinctum, Pfeiffer, Conch. Cab., *Cyclostoma*, 1854, p. 379, pl. 49, figs. 26–28.
Cyclotus filocinctus, Benson, Ann. & Mag. Nat. Hist., ser. 2, XIV, 1854, p. 416.
Cyclotus filocinctus, Adams, Genera of Recent Mollusca, II, 1855, p. 275.
Cyclotus filocinctus, Reeve, Conch. Icon., XIV, 1863, *Cyclotus*, pl. 9, fig. 50.
Cyathopoma filocinctum, Blanford, Ann. & Mag. Nat. Hist., ser. 3, XIII, 1864, p. 449.
Cyathopoma filocinctum, Blanford, Journ. de Conchyl., XIV, 1868, p. 258, pl. 12, fig. 1.
Cyathopoma filocinctum, Hanley & Theobald, Conch. Indica, 1876, p. 35, pl. 82, figs. 2 and 3.
Cyathopoma filocinctum, Theobald, Cat. Shells Brit. India, 1876, p. 38 (*pilocinctum*).
Cyathopoma filocinctum, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 258.
Cyathopoma (*s. str.*) *filocinctum*, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXXI, 1899, p. 136.
Cyathopoma filocinctum, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 135.

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The shell is small, globosely turbinated and translucent whitish, bearing a wide and deeply excavated umbilicus. The spire is rather elevated, subconical and the sutures are deeply impressed. The apex is papilla-like and is sometimes found missing in worn specimens. The whorls are rounded, the body whorl being almost cylindrically coiled. The aperture is circular and angulated above. The peristome is double, the internal lip being simple and straight while the external lip is slightly reflected. The surface of the shell is finely spirally ridged, the ridges being more numerous between the shoulder of the whorl and the umbilicus, but fewer and much weaker near the suture as well as by the side of the double peristome. The shell bears a brown, horny periostracum, but as this is deciduous the shells are generally found white without the periostracum.

Recorded localities : India : Nilgiris.

Specimens in the collection : Two shells, both from the Nilgiris. The shells are glossy and translucent whitish, with the papillary apex and the operculum wanting. In one of the shells, the periostracum is completely absent, while in the other, remnants of a dark horny brown periostracum are still persistent. Average measurements : Diameter, major : 3 mm. ; minor, 2.5 mm. The axis could not be determined accurately as the apex is missing in both the specimens. The shell resembles a miniature *Turbo* in external form..

Sub-family PUPININAE

Genus **Tortulosa** Gray, 1847

(Syn. **Cataulus** L. Pfeiffer, 1851)

The shell is elongately ovate, pupa-shaped, not very glossy, and narrowly umbilicated. The body whorl bears a filiform, basal keel. The aperture is cuircular and entire with an almost circular channel at the base. The peristome is continuous, and the operculum horny, circular, flattened and spirally whorled.

Tortulosa cumingi (Pfeiffer)

Plate III, figs. 1*a* and 1*b*

Cataulus cumingi, Pfeiffer, Proc. Zool. Soc. London, 1856, p. 339.
Cataulus cumingi, Theobald, Cat. Shells Brit. India, 1876, p. 41.
Cataulus cumingi, Jousseaume, Mém. Soc. Zool. France, VII, 1897, p. 311.
Cataulus cumingi, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 143.
Cataulus cumingii, Sowerby, Thes. Conchyl., III, 1864, pl. 264, fig. 3.
Cataulus cumingii, Reeve, Conch. Icon., XX, Pupinidae, 1876, pl. 6, fig. 52.
Cataulus thwaitesi ?, Sykes, Proc. Malacol. Soc. London, III, 1898, p. 68.
Cataulus thwaitesii (part), Hanley & Theobald, Conch. Indica, 1876, p. 43, pl. 106, fig. 6.
Tortulosa (*Eucataulus*) *cumingi*, Kobelt, Das Tierreich, Lief, 16, 1902, p. 284.
Tortulosa (*Eucataulus*) *cumingi*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 178.

The shell is elongately ovate, solid and more or less spindle-shaped, with a convexly turretted spire and an acuminated apex. The sutures are well impressed. There are eight whorls, the penultimate whorl being the most strongly convex, and the body whorl being rather narrowed below. Towards the base of the body whorl there is a strongly elevated spiral keel, below which

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the surface is deeply excavated, bounded on the right by the reflected inner lip of the aperture. The excavated part of the surface is strongly striated and leads into the narrowly perforated umbilicus. The aperture is subcircular, with a whitish margin, and bounded by a peristome which is continuous and strongly thickened, reflected and produced into a deep, notch-like canal at the base. The shell is pale horny brown, obliquely transpirally striated throughout the surface.

Recorded localities : Ceylon.

Specimens in the collection : A single shell from Haputale, Ceylon, with the operculum missing. Measurements : Length : 21 mm. ; Diameter at the middle : 8 mm. ; internal length of aperture, 5 mm. ; with the peristome :- 8 mm. These measurements are larger than the corresponding type measurements quoted by Gude (*loc. cit.*)

Tortulosa nietneri (Nevill)

Plate III, figs. 2*a* and 2*b*

Cataulus nietneri, Nevill, Journ. Asiatic Soc. Bengal, XXXIX, pt. 2, 1871, p. 7, pl. 1, fig. 7.
Cataulus nietneri, Reeve, Conch. Icon., XX, Pupinidae, 1876, pl. 6, fig. 48.
Cataulus nietneri, Theobald, Cat. Shells Brit. India, 1876, p. 41.
Cataulus nietneri, Nevill, Hand List Möll. Ind. Mus., I, 1878, p. 297.
Cataulus nietneri, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 309.
Cataulus nietneri, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 143.
Cataulus nietneri, Sykes, Proc. Malacol. Soc. London, III, 1898, p. 68.
Cataulus nietneri, Sykes, Journ. Malacol., XII, 1905, p. 55.
Tortulosa (*Eucataulus*) *nietneri*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 184.

The shell is rather narrowly and elongately ovate, fusiform, with a strongly raised, pyramidal spire. There are seven whorls gradually increasing in size from apex downwards, the body whorl and the penultimate whorl being large and somewhat inflated. The body whorl bears a strong spiral keel towards its base, surrounding the umbilicus. The aperture is circular and the peristome well marked and reflected with the usual notch at the base, but this is smaller and less conspicuous than in the other species of this genus. The operculum is normal, being of a light horny brown colour and composed of six whorls. The surface is sculptured with fine, transpirally oblique striae but the sculpture is obsolete in the apical whorls of the spire which are smooth and glossy. The shell is pale straw-coloured, irregularly marbled and streaked with greenish zig-zag markings. The shell of this species is smaller than that of all other species of this genus yet known, consisting of fewer whorls, with the body whorl somewhat flattened.

Recorded localities : Ceylon.

Specimens in the collection : A single shell, with the operculum intact and a smooth and shiny apex, from Watawala, Ceylon. Measurements : Length : 16 mm. ; maximum diameter : 7 mm. ; diameter of the aperture : 4 mm.

Two varieties of this species, with larger shells than the type have been described. The shell approaches the variety *caperata* Collett in its deeper sutures, smooth and horny apex and in its considerably large size, the measurements being much larger than those of the type quoted by Gude, but the close and strong wrinkling of the surface, said to be typical of *caperata* is not discernable in the present specimen.

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Tortulosa pyramidata (Pfeiffer)

Plate III, figs. 3*a* and 3*b*

Cataulus pyramidatus, Pfeiffer, Proc. Zool. Soc. London, 1852, p. 145, pl. 13, fig. 4.
Cataulus pyramidatus, Sowerby, Thes. Conchyl., III, 1864, pl. 264, fig. 10.
Cataulus pyramidatus, Reeve, Conch. Icon., XX, Pupinidae, 1876, pl. 7, fig. 60.
Cataulus pyramidatus, Hanley & Theobald, Conch. Indica, 1876, p. 58, pl. 146, fig. 5.
Cataulus pyramidatus, Theobald, Cat. Shells Brit. India, 1876, p. 41.
Cataulus pyramidatus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 297.
Cataulus pyramidatus, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 310.
Cataulus pyramidatus, Sykes, Proc. Malacol. Soc. London, III, 1898, p. 68.
Tortulosa pyramidata, Adams, Genera of Recent Mollusca, II, 1856, p. 285, pl. 86, figs. 2*a* and 2*b* (operculum).
Tortulosa pyramidata, Chenu, Man. de Conchyl., I, part 1, 1860, p. 489, text fig. 3617.
Tortulosa (*Eucataulus*) *pyramidata*, Kobelt, Das Tierreich, Lief. 16, 1902, p. 287.
Tortulosa (*Eucataulus*) *pyramidata*, Gude, Fauna, Brit. India, Mollusca, III, 1921, p. 186.

The shell is broadly ovate and pyramidal, solid, with the surface traversed throughout by fine, close-set, obliquely transpiral striae. The spire is turretted, with an acuminated apex. There are seven whorls, the lower whorls being somewhat convexly inflated. The body whorl is broad, not attenuated, and bears a strongly elevated spiral keel towards the base, surrounding the umbilicus. The part of the surface below this keel is more strongly and coarsely striated than the rest of the shell. The keel is slightly expanded anteriorly (i.e., towards its lower end). The aperture is large and subcircular. The peristome is whitish, continuous, thickened and strongly expanded and reflected. The notch at the anterior end of the peristome is rather deep and oblique. The umbilicus appears as a narrow but deep perforation at the base of the body whorl bounded by the reflected peristome on one side and the basal keel on the other. The operculum is dark horny brown, externally concave and multi-whorled. The shell is rufous brown.

Recorded localities : Ceylon ; Balapiti, Ceylon.

Specimens in the collection : A single shell, with the operculum *in situ*, from Udugama, Ceylon. Measurements : Length : 20 mm. ; maximum diameter : 9 mm. ; diameter of operculum : 4.5 mm. These dimensions are smaller than the smallest of the type measurements quoted by Gude (*loc. cit.*) and it is not improbable that the specimen examined is not a full-grown shell. Hanley & Theobald doubt the distinctness of this species from *T. austenianus* (Benson).

Tortulosa recurvatus (Pfeiffer)

Plate III, figs. 4*a* and 4*b*

Cataulus recurvatus, Pfeiffer, Proc. Zool. Soc. London, 1862, p. 116, pl. 12, fig. 2.
Cataulus recurvatus, Sowerby, Thes. Conchyl., III, 1864, pl. 264, fig. 16.
Cataulus recurvatus, Blanford, Journ. Asiatic Soc. Bengal, XXXV, 1866, p. 38.
Cataulus recurvatus, Hanley & Theobald, Conch. Indica, 1876, p. 58, pl. 146, fig. 2.
Cataulus recurvatus, Reeve, Conch. Icon., XX, Pupinidae, 1876, pl. 6, fig. 55.
Cataulus recurvatus, Theobald, Cat. Shells Brit. India, 1876, p. 41.
Cataulus recurvatus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 298.
Cataulus recurvatus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXIX, 1897, p. 143.
Tortulosa (*Eucataulus*) *recurvata*, Kobelt, Das Tierreich, Lief. 16, 1902, p. 287.
Tortulosa (*Eucataulus*) *recurvata*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 186.

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The shell is broadly and ovately pyramidal, solid, with the whorls fairly strongly inflated and the apex acuminated. There are seven whorls, gradually and regularly narrowed from below upwards, the three lowermost whorls being rather convex and more conspicuously inflated. The sutures are deeply impressed. The spiral keel towards the base of the body whorl is rather thin and sharply elevated and is distinctly dilated towards its basal end (i.e., anteriorly). The umbilicus is deep and narrow and bounded by the basal keel and reflected peristome. The basal part of the surface of the body whorl, enclosed by the keel is strongly and closely ridged. The aperture is rather large and subcircular and the peristome broad, distinctly double, expanded and reflected, and bent rather sharply backwards below the notch. The notch is large and deeply excavated, and bounded on each side by a tubercle-like prominence of the interrupted inner edge of the peristome. The operculum is dark horny brown, flattened and multi-spiral. The surface of the shell is traversed by very fine, close-set, obliquely transpiral striae. The shell is uniformly pale straw-coloured.

Recorded localities : Ceylon ; India : Anamalai Hills, Nilgiris and the foot of the Nilgiris.

Specimens in the collection : One shell, with the operculum intact, from the Anamalais. Measurements : Length : 24 mm. ; maximum diameter : 11 mm. ; diameter of aperture : 5 mm. These dimensions are slightly larger than the type measurements cited by Gude (*loc. cit.*). The apical whorls in this shell are slightly darker brown than the rest of the shell, and in portions where the straw-coloured periostracum has peeled away, the shell beneath is pure white.

Tortulosa templemani (Pfeiffer).

Plate III, figs. 5*a* and 5*b*

Cataulus templemani (nom. nud.) Pfeiffer, Zeits. Malak., VIII, 1851, p. 150.
Cataulus templemani, Sowerby, Thes. Conchyl., III, 1864, pl. 264, fig. 12.
Cataulus templemani, Hanley & Theobald, Conch. Indica, 1876, p. 43, pl. 106, fig. 1.
Cataulus templemani, Reeve, Conch. Icon., XX, Pupinidae, 1876, pl. 7, fig. 62.
Cataulus templemani, Theobald, Cat. Shells Brit. India, 1876, p. 41.
Cataulus templemani, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 310.
Cataulus templemani, Sykes, Proc. Malacol. Soc. London, III, 1898, p. 68 ; Journ. Malacol., XII, 1905, p. 55.
Pupina templemani, Pfeiffer, Proc. Zool. Soc. London, 1852, p. 158.
Tortulosa templemani, Adams, Genera of Recent Mollusca, II, 1856, p. 285.
Cataulus templemanni, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 297.
Tortulosa (*Eucataulus*) *templemani*, Kobelt, Das Tierreich, Lief. 16, 1902, p. 287.
Tortulosa (*Eucataulus*) *templemani*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 188.

The shell is rather narrow and fusiform, with eight whorls, the two whorls immediately above the body whorl being rather inflated, while the body whorl itself is somewhat narrowed below, thus rendering the shell characteristically spindle-shaped. The spire is elongately pyramidal, with an acuminated apex. The spiral keel at the base of the body whorl is prominent and sharply raised : the basal end of the keel is slightly dilated and the surface of the shell bounded by this keel is deeply excavated and coarsely transversely ridged. The umbilicus is rather narrow. The aperture is more or less ovate, being slightly produced basally. The peristome is continuous, bright orange red, widened into a thin flange-like expansion all round and produced

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below into an obtuse beak-like prominence. The basal notch is rather small. The operculum is horny, pale yellowish brown and slightly concave externally. The shell is pale rufous brown, very finely striated transpirally throughout.

Recorded localities : Ceylon ; Maturata, Ceylon.

Specimens in the collection : One shell, with the operculum *in situ*, from Haputale, Ceylon. Measurements : Length : 17 mm. ; maximum diameter : 6 mm. ; diameter of aperture (internal) : 4 mm. The shell is pale straw-brown, having lost most of its original colour except at the apex where it is slightly rufous brown.

Sub-family ALYCAEINAE

The shell is small, top-shaped, with a constriction behind the aperture and a backwardly directed sutural tube. The operculum is with or without an external calcareous layer, fitting into the peristome and sometimes with a process in the middle.

Genus **Alycaeus** Gray, 1850

The shell is heliciform or top-shaped with a more or less elevated, conical spire, or depressedly conical, and narrowly umbilicated. The whorls are rather convexly inflated and the sutures deep. The body whorl is somewhat distorted, being strongly compressed behind the margin of the aperture and bears a callous sutural tube. The aperture is circular and the peristome more or less thickened and reflected. The operculum is horny, multispiral, usually with an outer calcareous layer, externally concave, sometimes with a funnel-shaped process.

Alycaeus expatriatus Blanford

Plate III, figs. 6*a* and 6*b*

Alycæus expatriatus, Blanford, Journ. Asiatic Soc. Bengal, XXIX, 1860, p. 123.
Alycæus expatriatus, Hanley & Theobald, Conchologia Indica, 1876, p. 57, pl. 145, figs. 1 and 4.
Alycæus expatriatus, Theobald, Cat. Shells Brit. India, 1876, p. 39.
Alycæus expatriatus, Sowerby, in Reeve, Conch. Icon., XX, 1877, *Alycaeus*, pl. 5, fig. 45.
Alycæus expatriatus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 295.
Alycæus expatriatus, Godwin-Austen, Land & Freshwater Moll. India, II, 1914, p. 433.
Alycæus (*Charax*) *expatriatus*, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges. XXX, 1898, p. 129.
Alycæus (*Dicharax*) *expatriatus*, Kobelt, Das Tierreich, Lief. 16, 1902, p. 369, fig. 82.
Alycæus (*Dicharax*) *expatriatus*, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 249.

The shell is small, rather depressed, being more strongly depressed in the spire than any other Indian species of the genus. The surface of the shell is finely and closely transpirally grooved throughout. The body whorl bears a wide depressed area behind the peristome. This depression is traversed by a broad, tumid, ridge-like swelling which is sharper and more well marked in certain nearly allied species, but is relatively blunt in the present species. The aperture is circular and oblique, and the peristome continuous, with a thin, duplicated margin, and markedly recurved at the point where it meets the penultimate whorl. The sutural tube is

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moderately long, but its length is subject to considerable individual variation. The umbilicus is fairly large and deep. The shell is dull whitish or creamy white, theapical whorls being reddish brown. The operculum is horny, distinctly multispiral, and externally concave, the central nucleus being internally prominently papillated.

Recorded localities : Neddoowuttom Ghat, Nilgiris, Anamalais, South Canara and Shevroy Hills ; also at the base of the Neddoowuttom Ghat, north of the Nilgiris and a little above the village of Goodaloor.

Specimens in the collection : Four empty shells, slightly varying in size, and with their opercula missing, from the Shevroy Hills. The measurements of the largest of these, which appears to be considerably larger than the type specimen quoted by Gude, are as follows : Diameter, major : 7 mm. ; minor : 5 mm. ; axis 3·5 mm. ; diameter of aperture : 2 mm. The shells are of a dirty white colour, remnants of a blackish brown periostracum being present on parts of the surface in some of the shells.

The animal of this species is small and colourless, with a very short body and with the sole of the foot undivided, a rather short and pointed tail, the tentacles being short and yellowish, but all the shells represented in the Museum collection are dead and empty ones.

Family VIVIPARIDAE

The shell is top-shaped or turbinated, more or less elevated, narrowly or not at all umbilicated, with the whorls more or less inflated, seldom keeled and usually without sculpture, but sometimes with spiral striae. The aperture is ovate and the peristome is not thickened. The operculum is thin and concentrically whorled. This family includes, as the name suggests, viviparous freshwater snails, in which the right tentacle of the male is modified, being shorter than the left.

Sub-family VIVIPARINAE

The shell is turbinate, narrowly perforate or imperforate, with the whorls more or less convex and the operculum horny with excentric nucleus placed near the inner margin.

Genus **Viviparus** Montfort, 1810
(Syns. **Vivipara** J. Sowerby, 1813 ;
Viviparella Refinesque, 1815 ;
Paludina Lamarck, 1816)

The shell is either smooth or with spiral striae, rather thin. The whorls are more or less convex and inflated. The aperture is without any distinct groove or channel on its columellar margin. The shell is conoidal, with an obtuse apex. The operculum is horny, with an excentric, sublateral nucleus placed close to the inner margin.

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Viviparus bengalensis (Lamarck)

Plate III, figs. 7*a* and 7*b*

Paludina bengalensis Lamarck, Anim. sans vert., VI (2), 1822, p. 174.
Paludina elongata, Swainson, Zool. Ill., ser. 1, II, 1822, pl. 98 (top).
Paludina bengalensis and *P. gigantea*, Reeve, Conch. Icon., XIV, 1864, *Paludina*, pl. 2, figs. 5*a*, 5*b* and 7.
Paludina bengalensis, Küster, in Martini-Chemnitz, Conch. Cab., 1852, *Paludina*, I, p. 17, pl. 3, figs. 15 and 16.
Paludina bengalensis and *P. bengalensis* var. *gigantea*, Hanley & Theobald, Conch. Indica, 1876, pl. 76, figs. 8, 9 and 10, and pl. 77, fig. 5.
Paludina bengalensis, (part) Nevill, Hand List, Moll. Ind. Mus., II, 1885, pp. 20 and 21.
Vivipara bengalensis, Kobelt, in Martini-Chemnitz, Conch. Cab., 1909, *Paludina*, II, p. 271, pl. 55, figs. 1–4.
Vivipara bengalensis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 23.
Vivipara bengalensis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 83.
Vivipara bengalensis, Annandale, Rec. Ind. Mus., XIX, 1920, p. 113.
Vivipara bengalensis, Annandale & Sewell, Rec. Ind. Mus., XXII, 1921, p. 267.

This is the common Banded Pond Snail of India, and a detailed anatomical, systematic and bionomical account of this species has been given by N. Annandale and R. B. S. Sewell (*loc. cit.*). Ramanan (*loc. cit.*) has also described the soft parts of this snail and its habits. This species inhabits dirty ponds, tanks and sluggish streams. Specimens occur in large numbers in such habitats during the wet weather, but when the waters are dried up in the hottest part of the year, i.e., from May to August, they bury themselves in the mud to a depth of five or six inches and aestivate. Large numbers may be found dead on the banks of tanks and pools.

There has been much discussion among conchologists regarding the specific distinctness of the various alleged Indian species of *Viviparus*. Ramanan, in his discussion on the species of *Vivipara* (p. 23, *loc. cit.*) says that wherever he found Viviparas in any tank in the City of Madras, he had always come across all the four so called species, and that their animals never presented any differences in their external form, either in shape, colour or markings. The shells do present some apparent differences, but it is held that they are merely various phases in the life-history of a single species. Annandale and Sewell, however, in the systematic part of their much later publication cited above (p. 267, *loc. cit.*) have listed several races of *V. bengalensis*, and have mentioned only form *eburnea* as a race of *V. bengalensis*, and not *V. dissimilis* and *V. variata*, which they consider as distinct species. I have therefore followed these authors in treating these as separate species.

Viviparus bengalensis s. str.

The shell is ovately conoidal, sharply acuminate and with a relatively large, sub-circular or mango-shaped aperture. The upper part of the shell is more or less conical, and the whorls are somewhat strongly inflated, there being $5\frac{1}{2}$ to $6\frac{1}{2}$ whorls, separated by narrowly impressed sutures. The spire is relatively large, usually a little shorter, but occasionally longer than the body whorl. The body whorl is considerably broader than high. The umbilicus is narrowly perforate or completely closed, rarely more or less open. The columella is covered with a thin callus and strongly arched. The outer lip is sharp, thin and evenly semicircular. The operculum is moderately thin, horny, of a deep brownish colour and externally concave. The outer margin is strongly curved, the inner margin slightly sinuate and the posterior extremity rather blunt.

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The sculpture consists of very fine, close-set transpiral ridges, but the young shell bears rows of very fine punctures representing the bases of minute chetae. Only faint traces of spiral sculpture can be distinguished in adult shells normally. The colouration varies considerably, but as a rule the shell is a shining pale green or olive green, marked with brownish spiral bands, among which the broader ones generally alternate with narrower and paler linear bands.

Recorded localities : Northwestern provinces of India ; Bengal ; Southern India, Madras (Ramanan). Several geographical races are recorded by Annandale and Sewell, each with its own restricted distribution from various parts of India.

Specimens in the collection : Two shells from Cocanada, with their opercula missing. Both are almost of the same size. Also several spirit-preserved shells with their soft parts intact, from Bangalore ; these shells in spirit are brownish in colour. Average measurements : Length : 32 mm. ; maximum diameter : 20 mm. ; diameter of aperture, major : 15 mm. ; minor : 12 mm. The shells are glossy and pale olive green, spirally banded with brown. The interior of the shells is white. Annandale and Sewell record the *forma typica* of this species from the lower Ganges Valley, but as the present specimens from Cocanada and Bangalore agree with the typical form in all respects, they have been referred to here as *V. bengalensis s. str.*

Viviparus bengalensis var. **eburnea** Annandale & Sewell

Plate III, figs. 8*a* and 8*b*

Vivipara bengalensis, race *eburnea*, Annandale & Sewell, Rec. Ind. Mus., XXII, 1921, p. 274.

In this race the shell is slightly narrower than in the typical form and the aperture is relatively smaller. The body whorl is also less strongly inflated. The whorls are narrow and distinctly flattened immediately below the sutures. The transpiral striae are very fine, regualr and close-set. The aperture is pear-shaped and the umbilicus is very narrowly perforated. The shell is yellowish olive, with pale, indistinct spiral bands. Dead shells of this race are often found with the apices of their spires broken off, the shells consequently appearing obtuse and truncated towards the apex.

Recorded localities : This is the race that is commonly found in the large reservoirs of the Madras State and the central parts of India. It has been recorded from Sambalpur, Orissa, Godavary and in other districts of the Madras and Andhra States.

Specimens in the collection : Three rather worn, empty shells with their apices broken off, from Madras. Measurements of the largest of these specimens : Length : 25 mm. ; Diameter : 18 mm. ; diameter of aperture : major : 13 mm. ; minor : 9 mm. The largest of the three shells has the operculum *in situ*. It is dark horny brown and externally concave. In places where the outer periostracal layer has peeled away, the glossy, ivory-white deeper layer of the shell is exposed in these shells.

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Viviparus variata (Frauenfeld)

Plate IV, figs. 1*a* and 1*b*

Paludina variata, Frauenfeld, Verhandl. Zool.-Bot., Gesellsch Wien, 1862, p. 1163.
Paludina variata, Hanley & Theobald, Conch. Indica, 1876, p. 47, pl. 115, fig. 8.
Paludina carinata and *P. variata*, Reeve, Conch. Icon., XIV, 1864, *Paludina*, pl. 9, fig. 53 and pl. 10, fig. 58.
Vivipara variata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 23.
Vivipara variata, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 89.

The shell is considerably smaller in average size than that of *V. bengalensis* and is rather broad and ovately conical with moderately inflated whorls and a narrowly perforated umbilicus. The body whorl bears a rather feebly developed, yet well defined, spiral keel at about the level of its middle. The sutures are well impressed. The sculpture consists of numerous, regularly disposed, very fine, punctated spiral striae, and in addition to these, there are numerous weak transpiral growth lines. The whorls are five in number and feebly depressed round their upper parts (i.e., immediately below the sutures). The aperture is ovately pear-shaped and the operculum is horny, flattened, multi-whorled and excentrically nucleated. The columellar margin of the aperture is covered with a thin callus layer. The peristome is black and highly glossy in fresh shells. The interior of the aperture is of a smoky bluish colour. The outer surface of the shell is dull olive green, brownish towards the apex and moderately glossy in fresh specimens.

Recorded localities : Pondicherry, Madras.

Specimens in the collection : Several specimens of dead, empty shells, ranging in size from young shells measuring 14 mm. to adult ones extending up to 26 mm. in length, from Conjeevaram, Red Hills Lake, Sembarampakkam, Chingleput District, Bangalore and Madras. I have collected several worn and empty shells of this species from the dried up salt marshes at Tada, north of Ennur, while on trips to collect birds in this area. In young shells the keel on the body whorl is sharper and more well defined, and the shell is thinner and more highly glossy. In most worn shells, however, the apical whorls are missing. The operculum is intact in a few of the specimens. Average measurements: Height : 21 mm. ; maximum diameter : 16 mm. ; aperture : height : 11 mm. ; diameter : 9 mm. Hanley and Theobald are inclined to believe that Reeve's species *Paludina variata* (*loc. cit.*) might prove to be a squat form of either *V. dissimilis* or *V. remossi*.

Viviparus dissimilis (Müller)

Plate IV, figs. 2*a* and 2*b*

Nerita dissimilis, Müller, Hist. Verm., pt. 2, 1774, p. 184.
Nerita dissimilis, Schroter, Einleit. Conch., II, p. 253, pl. 4, fig. 10.
Helix dissimilis, Gmelin, Syst. Nat., 3647.
Nerita dissimilis, Dillwyn, Desc. Cat., p. 941.
Paludina remossii, Kuster (non Philippi) ed. Chemn., *Paludina*, p. 26, pl. 5, figs. 17 and 18.
Paludina melanostoma, Reeve, Conch. Icon., XIV, 1864, *Paludina*, pl. 5, fig. 27.
Paludina dissimilis, Hanley & Theobald, Conch. Indica, 1876, p. 33, pl. 77, figs. 3 and 4.
Vivipara dissimilis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 23.
Vivipara dissimilis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 87.
Vivipara dissimilis, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1919, p. 27.
Vivipara dissimilis, Annandale, Rec. Ind. Mus., XIX, 1920, p. 113.
Vivipara dissimilis, Annandale & Sewell, Rec. Ind. Mus., XXII, 1921, pp. 215–292.

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This is another common Indian species of the genus *Viviparus* and Annandale and Sewell (*loc. cit.*, 1921) have described in detail many points in the anatomy and ornamentation of the embryonic and adult shell of this species, and have drawn comparisons between this species and *V. bengalensis* and other related species.

The shell is large and relatively more broadly ovate than in the preceding species, and very narrowly umbilicated. The body whorl is somewhat indistinctly angulated round its upper part and about its middle where it is marked by the presence of a very feebly developed spiral keel. The sculpture consists of very fine, close-set, punctate spiral striae and obliquely transpiral growth striae, a few of which at rather wide and irregular intervals (especially towards the peripheral end of the body whorl) are strong and well marked. In this species traces of the embryonic periostracal sculpture are more persistent than in the others. The aperture is ovate, with a sharp, thin, blackish peristome and a thin callus layer on its columellar margin. The operculum is horny, brownish, externally slightly concave and angularly pointed above. The periostracal layer is dull olive greenish, beneath which the calcareous surface of the shell shows up as pure ivory white patches where the periostracum has peeled away. The interior of the aperture is dull bluish white.

Recorded localities : The typical form has been recorded from Calcutta, Kondooruwave, etc., in Bengal, and from Madras (Ramanan), but several local varieties have been recorded from Sind, Kathiawar, Ferozpur, Assam and Cutch.

Specimens in the collection : Two dead shells, with worn out spires and the periostracum rubbed away in extensive patches, from Mudgiri, Mysore. In one of these shells the operculum is intact. Measurements : (of the larger shell) : Height : 27 mm. ; diameter : 20 mm. ; aperture : height : 12 mm. ; diameter : 9 mm. One of these shells is peculiar in that the umbilicus is completely closed. This is probably a secondary condition. In both these shells the apical whorls are brownish and badly corroded, the apex being completely worn out, this being the condition in which most empty shells of this and allied species of *Vivipara* are usually collected.

Family AMPULLARIIDAE

The shell is moderately to considerably large, usually rounded, rarely broad and discoidal, as a rule dextral, except in the genus *Lanistes*, in which the shell is sinistral. The aperture is more or less large, ovate, without any groove or canal. The operculum is concentric, with the nucleus placed near the columellar margin and is usually moderately thin and horny, but calcified in the genus *Pila*.

Genus **Pila** (Bolten) Röding, 1798

The shell is dextral, rounded and globosely inflated, turbinate, with the spire only slightly exserted above the level of the body whorl. The umbilicus is either narrowly perforated or completely closed. The aperture is elongately ovate, the apertural margin being often internally somewhat thickened. The operculum is usually moderately flattened and calcareous.

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This genus includes the familiar large apple snails or pond snails inhabiting clear waters with plenty of fresh aquatic vegetation. They are common in wet paddy fields and in marshes from August to October, in and around Madras.

Pila globosa (Swainson)

Plate IV, figs. 3*a* to 3*c*

Ampullaria globosa (Swainson), Zool. Illustr., ser. 1, ii, 1822, pl. 119.
Ampullaria orbata, Mörch, Martens, Mal. Bl., 1857.
Ampullaria globosa, Philippi, Monogr. Ampul., (Kuster's ed. Chemnitz), p. 8, pl. 1, fig. 3.
Ampullaria globosa, Hanley & Theobald, Conchologia Indica, 1876, p. 46, pl. 113, figs. 3–5.
Ampullaria globosa, Reeve, Conch. Icon., X, 1858, *Ampullaria*, pl. 10, figs. 46 and 47.
Ampullaria globosa, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 28.
Ampullaria globosa, Ekendranath Ghosh, Rec. Ind. Mus., VII, 1912, p. 77 (nervous system).
Pila globosa, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 97.
Pila globosa, Prashad, Mem. Ind. Mus., VIII, 1925, p. 70 ; pl. 13, figs. 1–7 ; p. 91 ; pls. 16–18 (anatomy).
Pila globosa, Prashad, "*Pila*", Indian Zoological Memoirs, IV, 1932, p. 5.
Pila globosa, Ranjah, A.R., Rec. Ind. Mus., XLIV, 1942–46, p. 217 (Embryology).

Ramanan, in his paper cited above, has recorded two other species, viz., *Ampullaria carinata* and *A. malabarica* from Madras and its vicinity, but states that these may only be variations of the typical *A. globosa* as transitional stages between all the three forms may be found in a well arranged series from the same tank. Forms with bright bands are grouped as *A. carinata* and those with little banding and somewhat more acuminated spire are referred to as *A. malabarica*. However, these have been originally treated as distinct species by earlier authors and later as synonyms of *P. virens* by Prashad, but no labelled specimens of these so called "species" are represented in the Museum collection.

The shell of *Pila globosa* is large, and as the specific name indicates, globose, with the whorls strongly inflated and rounded. The surface is smooth and glossy in fresh shells. In the typical form the spire is depressed, and the margin of the aperture thickened. The umbilicus is narrowly perforated and is bounded by the raised peristome which is slightly reflected at this part. The operculum is calcareous. Madras shells usually have a deep orange-brown peristome and a yellowish olive periostracum. The shell is spirally banded, but the extent of the spiral banding varies with different shells, and is best seen when the shell is living and the periostracum is in a fresh condition. The interior of the shell is of a glossy yellowish hue, traversed by reddish transverse bands. Strong, transpiral growth striae are sometimes well marked on the body whorl, especially towards the aperture.

These snails usually live in clear waters filled with aquatic vegetation. Sometimes they burrow deep into the mud or crawl on the sand banks of rivers and ponds at considerable distances away from water in quest of food. They are common in marshes from August to October.

Recorded localities : Calcutta, Rohilkund, Orissa, etc., ; Madras (Ramanan).

Specimens in the collection : Several worn out dead and empty shells of various sizes from Tada and Sembarampakkam, Chingleput District and three fairly fresh spirit-preserved specimens with the soft parts and opercula intact from Kunnavaram, East Godavary District, are

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contained in the collection. The measurements of the largest specimen (empty shell) in the collection (from Tada) are as follows : Height : 54 mm. ; diameter : 51 mm. ; aperture : height 41 mm. ; diameter : 23 mm.

All the empty dead shells are worn and bleached almost uniformly white. In one or two of them, the yellowish olive ground colour and faint brownish spiral bands are discernable. Of the three shells (preserved in spirit) from Kunnavaram, one is an adult shell with a weedy encrustation on part of the surface and is olive brownish, with darker brown, almost chestnut spiral bands. The remaining two are young specimens with thin yellowish, olive shells with brown spiral bands towards the basal part of the shell. The operculum is calcareous, externally concave, smooth and glossy outsise in the adult shell. The measurements of the smaller of the two young shells form Kunnavaram are as follows : Height : 21 mm. ; diameter : 20 mm. ; aperture : height : 15 mm. ; diameter : 9 mm. In the adult spirit-preserved shell, the periostracal layer has peeled off over a small part of the surface, exposing the pale yellowish white internal calcareous layer.

Pila virens (Lamarck)[1]

Plate IV, figs. 4*a* and 4*b*

Ampullaria virens, Lamarck, Hist. Anim. sans vert., VI, 1822, p. 179.
Ampullaria carinata, Swainson (nec Lam.), Zool. Illus. ser. 2, 1829, pl. 9.
Ampullaria globosa var. *layardi* sub var. *virens*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 3.
Pila layardi var. *virens*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915,p. 99.
Pila virens, Prashad, Mem. Ind. Mus., VIII, 1925, p. 75 ; pl. 14, figs. 1–3.
Pila virens, Prashad, "*Pila*", Indian Zoological Memoirs, IV, 1932, p. 6.

The shell closely resembles that of the preceding species, and is chiefly distinguished from the latter in the spire being relatively more strongly depressed and about one-fourth of the total length of the shell, the whorls of the spire being less markedly inflated and the umbilicus being much smaller and more narrowly perforated. The shell is rather compressedly globose, the whorls being somewhat horizontally depressed round the upper part, but well rounded below. The surface is smoth and glossy, but finely transpirally striated throughout. The umbilicus is small, narrow and almost occluded by the overlapping peristomial edge. The aperture is ovate, rather narrowed above and broader below. The operculum is horny, pale fleshy brown, concave externally and finely concentrically striated. The shell is whitish, covered with an olive greenish horny periostracum. This species closely resembles the typical form, *Pila layardi* (Reeve) (to which it is closely allied) in all respects, except that the carination at the suture is obsolete. *P. layardi* is recorded from Colombo, Ceylon, but *P. virens* has a much wider range of distribution in Peninsular India.

Recorded localities : Kollam ; from Peninsular India, through Orissa and Bengal to Assam ; Pondicherry and farther south.

1. The species *Pila virens* has been treated as a variety of *Pila layardi* (Reeve) by Preston in his volume on Mollusca in the Fauna of British India series (*loc. cit.*), but later Prashad has established its status as a distinct species, and has cited *P. carinata*, *P. malabarica*, *P. maura*, *P. paludinoides*, and *P. largillierti* as synonyms of this species in his "Revision of the Indian Ampullariidae", *Mem. Ind. Mus.*, VIII, 1925, (p. 75) to which reference may be made for a detailed list of synonymies and references for this species, which, however, is closely related to *P. layardi*.

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Specimens in the collection : Two shells, an adult, with the operculum *in situ* and a young, half-grown one with the operculum missing, labelled *Pachylabra virens* (Lamarck) from Red Hills Lake, Madras, are represented in the gallery collection. *Pachylabra* Swainson, is a synonym for *Pila* s. str. In the adult shell, the olive greenish periostracum has peeled away in extensive patches exposing the white inner layer and in the young shell, a faint, irregular pale brownish spiral banding is visible on the surface of the body whorl. The operculum in the adult shell is horny and dull fleshy brown, with close striations on the outside. Internally, the operculum is bright fleshy pink, glossy, with the site of the muscular attachment well marked by an ovate, whitish depression in the centre of which is a raised, narrow, linear fleshy pink scar. The edge of the outer lip of the aperture is blackish brown externally in the adult shell. Measurements : Adult shell : Height : 50 mm. ; diameter : 46 mm. ; aperture : height : 36 mm. ; diameter : 20 mm. Young (half-grown) shell : Height : 29 mm. ; diameter : 26 mm. ; aperture : height : 22 mm. ; diameter : 12 mm.

SERIES LITTORINACEA

Family LACUNIDAE

The shell is usually of small size and of variable form, colourless, or with brown bands, as a rule thin-walled and with smoother outer surface. The aperture is rounded or ovate. The operculum is thin, with few whorls.

Genus **Mainwaringia** Nevill, 1884

The shell is turretted, pointed, not umbilicated, with numerous inflated and spirally grooved whorls, brownish, with dark coloured spiral bands. The aperture is moderately small and elliptical, angularly pointed above and below. The peristome is sharp. The operculum bears rapidly enlarging whorls and is of a light, horny brown colour.

This genus was regarded by earlier authors as a connecting link between *Melania* and *Paludomus* owing to its superficial resemblances, but taxonomically it is more nearly related to the Littorinids, and is distinguished by the presence of hairs or bristles on the shell, especially on the body whorl, which is ornamented with broad, brownish spiral bands.

This was originally described by Nevill as a subgenus of *Melania*, but has been subsequently treated by Thiele as a distinct genus, included in a separate family, the Lacunidae, in a different series altogether, the Littorinacea.

Mainwaringia paludomoidea (Nevill)

Plate IV, figs, 5*a* and 5*b*

Melania (*Mainwaringia*) *paludomoidea*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 286.
Tiara (*Mainwaringia*) *paludomoidea*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 37.
Melania (*Mainwaringia*) *paludomoidea*, Annandale & Prashad, Rec. Ind. Mus., XVI, 1919, pp. 251 and 252 ; pl. 20, fig. 8.

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The shell is very small, almost minute, more or less spindle-shaped, the spire being turretted and terminating above in a very sharply pointed apex. The sutures are distinct and well impressed. The surface of the shell is regularly spirally striated below the slight subangular shoulder in each whorl, the striae being well marked and with a minutely punctated appearance. The surface of the shell bears conspicuous hairs or fine bristles especially on the body whorl ; this covering of hairs is specially well marked in fresh shells. The whorls are nine in number, the three uppermost ones being extremely minute, whitish and devoid of sculpture. The body whorl is rather convex and inflated, and of about the same height as the spire. The aperture is rather small, ovate, with a thin-edged peristome. The columellar margin is thickened, dark violet in colour, obliquely arched and sharply angulate at the base. The operculum is translucent, and of a light horny brown colour. The shell is of a rather yellowish, bright horn colour, with three distinct, broad, dark brown spiral bands on the body whorl, which show clearly through the thin shell wall within the aperture.

Recorded localities : Mutlah River at Port Canning. Specimens of this species were originally found by Col. Mainwaring (after whom this species has been named) " in brackish water on trunks of trees submerged at high tide." Annandale and Prashad (*loc. cit.*) have recorded it from the Gangetic Delta.

Specimens in the collection : A single dry-preserved shell, collected by Dr. Gravely from Ennur, Chingleput District. This is perhaps the first record of this species from a locality in South India. The spiral striations, angulations on the whorls and the hairs on the surface are fairly distinct in the present specimen under the lens, but the dark-coloured spiral bands on the body whorl are faded. Measurements : Height : 5 mm. ; diameter : 2·5 mm. ; height of aperture : 2 mm. It is apparently a young shell, as its measurements are much smaller than those of the type specimen cited by Nevill (*loc. cit.*).

Family POMATIASIDAE

The shell is depressedly turbinated or elongately cone-shaped, often with spiral grooves. The aperture is rounded and the peristome thin, simple or expanded. The operculum is spirally whorled, externally covered with a calcareous layer.

Sub-family POMATIASINAE

The shell is top-shaped or ovate, usually with spiral striae ; the aperture is rounded or ovate. The operculum bears a spirally whorled calcareous layer externally.

Genus **Cyclotopsis** Blanford, 1864

The shell is moderately widely umbilicated, more or less depressedly top-shaped. The whorls are inflated and bear spiral grooves on the surface. The aperture is oblique and rounded, and the peristome somewhat expanded and covered with a callus deposit. The operculum is multispiral, internally somewhat concave and composed of a double layer, the inner being membranous and the outer calcareous ; the edges of the whorls of the operculum are raised.

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Cyclotopsis subdiscoidea (Sowerby)

Plate IV, figs. 6*a* and 6*b*

Cyclostoma subdiscoideum, Sowerby, Thes. Conchyl., I, 1850, p. 161, pl. 31*b*, fig. 304 and 305.
Cyclostoma subdiscoideum, Pfeiffer, Conch. Cab., Cyclostomaceen, 1854, p. 318, pl. 41, figs. 33 and 34.
Cyclotus subdiscoideus, Adams, Genera of Recent Mollusca, II, 1855, p. 275.
Cyclotus subdiscoideus, Reeve, Conch. Icon., XIV, 1863, *Cyclotus*, pl. 4, fig. 21.
Cyclotus subdiscoideus, Hanley & Theobald, Conch. Indica, 1876, p. 2, pl. 4, fig. 10.
Cyclotopsis subdiscoideus, Theobald, Cat. Shells Brit. India, 1876, p. 35.
Cyclostoma (*Cyclotopsis*) *subdiscoideum*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 308.
Cyclotopsis subdiscoidea, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., XXX, 1898, p. 157.
Cyclostoma aratum, Benson, Ann. & Mag. Nat. Hist., ser. 2, VIII, 1851, p. 190.
Cyclostoma rusticum, Pfeiffer, Proc. Zool. Soc. London, 1851, p. 250.
Cyclotus pfeifferi, Gray, Nomencl. Moll. Brit. Mus., part 1, 1850, p. 9 (nom nud.).
Cyclotopsis subdiscoidea, Gude, Fauna Brit. India, Mollusca, III, 1921, p. 354.

The shell is rather depressed, discoidal and suborbicular. The body whorl is moderately inflated and is strongly obliquely inclined downwards towards the apertural margin. The spire is obtuse, depressedly conical, with four whorls. The sutures are well impressed but only very slightly channelled. The surface of the shell is closely and finely spirally grooved throughout, this being a characteristic feature of the present genus. The aperture is circular and strongly obliquely inclined. The periostome is thin, whitish, slightly reflected and is spread out slightly as a callous expansion posteriorly over the under surface of the body whorl. The umbilicus is very large and widely open exposing the four whorls of the spire from beneath. The shell is whitish or pale straw-coloured, marked with a series of pale brownish, interrupted transpiral bands. There are also two more or less distinct brownish spiral zones on the body whorl.

Recorded localities : South India, Northern Circars, Orissa ; Cuttack, Orissa.

Specimens in the collection : A single dead shell with the operculum missing, from Tirupathi Hills, Chittoor District, collected by Mr. R. V. Seshaiya, and identified for us by Dr. Baini Prashad. The shell is typical in all respects and closely resembles the figure of the British Museum specimens (Gude, *loc. cit.*, p. 355), but is considerably larger than the type. Measurements : Diameter : major : 20 mm. ; minor : 17 mm. ; height : 12 mm.

SERIES RISSOACEA

Family HYDROBIIDAE

(= PALUDESTRINIDAE)

The shell is small, corneous, either conical or turretted, sometimes depressedly whorled, usually smooth, seldom with the ribs or striae, either imperforate or narrowly perforated, seldom openly umbilicated. The aperture is ovate and the peristome continuous and not infrequently thickened. The operculum is horny and, as a rule, spirally whorled.

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Sub-family BITHYNIINAE

The shell is ovate or ovately conical, usually smooth, more rarely with spiral striae. The operculum is calcified, without internal appendage. The animal bears a simple foot and a bifid penis.

Genus **Bithynia** Leach, 1818

(Syn. **Bulimus** Scopoli, 1777, part)

The shell is small, ovately spindle-shaped, as a rule colourless, smooth, or rarely with spiral sculpture, usually imperforate. The whorls are more or less convexly inflated and the aperture is, as a rule, ovate with a continuous peristome. The operculum is testaceous.

Bithynia stenothyroides Dohrn

Plate V, figs. 1*a* and 1*b*

Bithynia stenothyroides, Dohrn, Proc. Zool. Soc. London, 1857, p. 123.
Bithynia stenothyroides, Hanley & Theobald, Conch. Indica, 1876, p. 18, pl. 38, fig. 7.
Bithynia stenothyroides, Theobald, Cat. Shells, Brit. India, 1876, p. 14.
Bithynia stenothyroides, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 17.
Bithynia stenothyroides, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 77.

The shell is small, ovate, translucent whitish and glossy. There are four to five whorls, the body whorl being rather unusually large in proportion to the spire and strongly inflated. The sutures are simple, and the aperture oblong-ovate and somewhat contracted. The surface of the shell is smooth, without any trace of sculpture. The spire is comparatively short and broadly conical. The operculum is oblong-ovate, testaceous, thick and concentrically striated.

Ramanan (*loc. cit*) has pointed out some interesting differences which he noticed between the Madras shells of this species which he had examined and Dohrn's original description of the species. The shells collected at Madras are generally slightly larger than the type dimensions quoted by Preston (*loc. cit.*). They have a dirty greyish olive periostracum beneath which the shell is white. Most shells from Madras have five distinct whorls and in some shells the apical whorl is somewhat depressed within the level of the next whorl. The peristome is either fulvous or brownish.

Living specimens of this species are abundant in slow-moving streams and stagnant ponds and tanks filled with decaying vegetation. They are also common in the beds of partially dried up ponds and are gregarious in habit.

Recorded localities : Ceylon, Nilgiris, Poona, Madras, S. Arcot, Tiruchirapalli, etc.

Specimens in the collection : Two empty dead shells from Madras. The shells are translucent whitish, with a glossy surface, and are larger than the type measurements quoted by Preston (*loc. cit.*). Measurements : Height : 7 mm. ; diameter : 5·5 mm. ; aperture : height : 3·5 mm. ; diameter ; 2·5 mm. The operculum is missing in both the shells.

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Genus **Mysorella** Annandale, 1919

(Syn. **Mysoria** Godwin-Austen, 1918, non E. Y. Watson, 1893)

The shell is top-shaped, openly umbilicated, with a moderately elevated spire, a large, rounded body whorl, and uniformly distinct spiral ribs. The aperture is oblique and rounded, with a continuous and somewhat thickened peristome. The operculum is concentric and externally concave.

Mysorella costigera (Küster)

Plate V, figs. 2*a* and 2*b*

Bithynia (? *Fossaurulus*) *costigera*, Küster, Conch. Cab., *Paludina*, p. 33, pl. 7, figs. 18 and 19.
Valvata sulcata, Eyd. & Soul., Voy. , Bonite ', Zool., p. 517, pl. 31, figs. 19–21.
Bithynia costigera, Hanley & Theobald, Conch. Indica, 1876, p. 60, pl. 151, fig. 10.
Bithynia (? *Fossaurulus*) *costigera*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 78.
Mysoria costigera, Godwin-Austen, Rec. Ind. Mus., XVI, 1919, pp. 210 and 211.
Bithynia costigera (assigned to *Mysorella*), Annandale, Rec. Ind. Mus., XIX, 1920, p. 43.
Mysorella costigera, R. V. Seshaiya (Anatomy), Rec. Ind. Mus., XXXII, 1930, pp. 1–28.

This species is the type of the genus *Mysorella* (originally known as *Mysoria*, but subsequently changed to *Mysorella*, as the name *Mysoria* was preoccupied for a genus of insects). The shell of this species bears a very close superficial resemblance to that of the Littorinid *Cremnoconchus syhadrensis*, but their habits are quite different. *Cremnoconchus* frequents vertical rocks kept moist by the spray from waterfalls, while *Mysorella* inhabits the edges of ponds and flooded rice-fields where it burrows into the mud in the dry season.

The shell is small, rather thick, ovately conical, solid and turbinated, ornamented with strongly raised spiral ridges. In the intervening spaces between the main spiral ribs, there are finer and weaker secondary spiral ridges. The uppermost of the main spiral ridges is well developed and forms a more or less well marked shoulder in each whorl. The spire is well raised and the body whorl moderately inflated. The aperture is sub-circular and oblique. The shell is conspicuously umbilicated and the peristome continuous, prominent and thickened, somewhat more strongly so on the columellar side. The operculum is calcareous, not very thick, broadly ovate and concave externally, the nucleus being small and centrally situated ; it is almost smooth internally. The shell is uniformly pale horny brown, without indications of any definite colour markings.

A variety with a shorter shell and less exserted spire and chestnut brown periostracum (var. *curta* Nevill) has been recorded from Bangalore, S. India, but this is not represented in the Museum collection.

Recorded localities : Bengal, Pondicherry, Ceylon, Southern part of Madras State and in the neighbourhood of Madras city.

Specimens in the collection : Four dry shells, two with their opercula intact, from Madras, and another lot of eight dry shells in the reserve collection, seven of which have their opercula intact, collected from a pond in Egmore, Madras, by Dr. F. H. Gravely. All these shells have

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their apices intact, but only one of the four in the first set in the gallery collection has the apex intact. Average measurements : Height : 7·5 mm. ; diameter : 5·5 mm. ; aperture : height : 4 mm.

Family ASSIMINEIDAE

The shell is small, being almost always smaller than 10 mm. ; usually ovately conical, either elevated or depressed. The aperture is rounded or ovate, usually angular above. The operculum is, as a rule, horny, sometimes calcified. The proboscis and foot are short, the sole being without any median groove and the pallial cavity without gills. This family includes land shells, or shells inhabiting the edges of freshwater tanks, ponds, etc.

Sub-family ASSIMINEINAE

The shell is ovately conical, sometimes elongately conical or rounded. The eyes are borne on short stalks, near their tips.

Genus **Assiminea** (Leach) Fleming, 1828

(Syns. **Optediceros** Leith, 1853 ;
Assemania Knight, 1900)

Shell characters more or less the same as those of the family and the sub-family.

Assiminea rubella Blanford

Plate V, figs. 3*a* and 3*b*

Assiminea rubella, Blanford, Journ. Asiatic Soc. Bengal, XXXVI, (ii), 1867, p. 55.
Assiminea rubella, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, pp. 21 and 94.

The shell is small, dull orange red and broadly and ovately conical. The spire is moderately elevated and conical with a fairly sharp and pointed apex. The surface of the shell is smooth, but immediately below the suture there is a distinct impressed double spiral line in each whorl, and this is a characteristic feature of this species. The aperture is ovate, rather narrowed above, with a thin, sharp-edged peristome. The basal part of the shell, adjoining the columellar border is much paler, almost whitish. Living specimens of this species are often found abundantly crawling on wet mud exposed by the receding tide in the mangrove swamps of the Ennur backwater. The animal is deep red, with a black spot upon each of the lobes into which the proboscis is divided. The eyes are at the tip of the short tentacles.

Recorded localities : Port Dalhousie, Ennur backwater, Madras.

Specimens in the collection : Several specimens preserved in spirit, with well expanded soft parts, collected from mangrove swamps in Ennur backwaters, Chingleput and Cocanada. The shells are all dull orange-red in colour. Average measurements : Height : 5 mm. ; diameter : 4 mm. ; aperture : height : 3 mm. ; diameter : 1.5 mm.

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Assiminea brevicula (Pfeiffer)

Plate V, figs. 4*a* and 4*b*

Assiminea brevicula, Nevill, Journ. Asiatic Soc. Bengal, L(1), 1881, p. 159, pl. vii, fig. 6.
Assiminea brevicula, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 67.
Assiminea brevicula, Böttger, Jahrb. deutsch. Malakozool. Ges., XIV, 1887, p. 163.
Assiminea brevicula, von Martens, in Weber's Zool. Ergeben, Neiderl. Ost.-Ind., IV, 1897, p. 213.
Assiminea brevicula, Annandale & Prashad, Rec. Ind. Mus., XVI, 1919, p. 250.
Assiminea brevicula Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, pp. 21 and 94.

The shell is very small, pale brownish, ovately conical, with an obtuse, broadly conical spire bearing somewhat inflated whorls. The sutures are well impressed and there is only a single infrasutural impressed spiral line, whereas in *A. rubella* there is a double impressed spiral line below the sutures. The aperture is broadly ovate, comparatively broader in proportion to the height than in the preceding species. The Madras shells in the collection are much smaller in average size than those of *A. rubella*, and are typically of a pale horny brown colour, though most of the shells preserved in spirit have lost much of their brown colour and are practically dull white in colour. This species is very variable and widely distributed, and in the Madras area it has been collected from the Adyar backwater by the late Mr. M. D. Crichton in 1940. Annandale & Prashad (*loc. cit.*) have figured and described the radular teeth of this species.

Recorded localities : Adyar, Madras, Singapore, Malacca, Andamans, Borneo, Irrawady Delta, Port Canning, Arakan, Philippines and Amoy. This species is said to be very common on mud between tide marks in the lower part of the Gangetic Delta. Its distribution extends from the Gangetic estuaries eastwards to Central China.

Specimens in the collection : Several small shells, preserved in alcohol from the Adyar backwater, Madras, some of them with the soft parts intact. Average measurements : Height : 3 mm. ; diameter : 1.75 mm. The Madras shells in the Museum collection are much smaller than the Port Canning specimens, measurements of which are quoted by Nevill (*loc. cit.*) as 7 mm. long and 5 mm. wide.

Assiminea woodmasoniana Nevill

Plate V, figs. 5*a* and 5*b*

Assiminea woodmasoniana, Nevill, Journ. Asiatic Soc. Bengal, XLIX (ii), 1880, p. 163.
Assiminea woodmasoniana, Nevill, Hand List, Moll. Ind. Mus., II, 1884, p. 69.
Assiminea woodmasoniana, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, pp. 21 and 94.

The shell is very small, imperforate (or minutely perforated), with an elongately conical spire and a sharply pointed apex. A small, almost obsolete keel surrounds the very minute perforation (which is often completely closed up). The sutures are well impressed, and the whorls numbering about seven, are moderately convexly inflated, and regularly widening from above downwards. The body whorl is somewhat compressed and obviously angulated below. The aperture is ovate and oblique, with its columellar margin thickened conspicuously with callus.

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The surface of the shell is smooth and glossy. The shell is greyish black over the greater part of the surface, but pale horny brown towards the base of the body whorl and reddish brown towards the apex. The animal of this species is transparent, with large, intensely black eyes situated on the upper side and near the extremity of the tentacles. The soft parts of this species have been observed and described by Mr. J. Wood-Mason after whom it is named.

Recorded localities : Port Canning, near Calcutta ; Chandipal ; Madras ; Bombay (var. ?).

Specimens in the collection : Numerous dry shells from a freshwater tank in Purasawalkam, Madras, are contained in the collection. A few of the shells are bleached into a more or less uniformly pale horny brown. Average measurements : Height : 4 mm. ; diameter : 2·5 mm.

Assiminea hungerfordiana Nevill

Plate V, figs. 6*a* and 6*b*

Assiminea hungerfordiana, Nevill, Journ. Asiatic Soc. Bengal, XLIX (ii), 1880, p. 165.
Assiminea hungerfordiana, Nevill, Hand List, Moll. Ind. Mus., II, 1884, p. 69.
Assiminea hungerfordiana, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, pp. 21 and 94.

The shell is very small, solid, imperforate, ovately conical and smooth. The sutures are rather indistinct and feebly impressed. The spire is short, but well produced and broadly conical. The body whorl is comparatively large and regularly ovoid. The columella is straight and only slightly twisted, forming a more or less distinct angle at its base. The aperture is vertical, with its external margin thin and its columellar margin thickened. The shell is rich chocolate-brown or chestnut-brown in colour, the upper portions of the whorls being of a darker and duller shade. The surface of the shell is smooth, but distinct growth striae can be made out under a strong magnifying glass.

Recorded localities : Rangoon ; mouth of the Rangoon River ; Madras.

Specimens in the collection : A single dead shell collected from the Cooum River near Anderson Bridge at Madras. The spire is chestnut-brown, but the body whorl is bleached into a pale straw brown in this shell. Measurements : Height : 4·5 mm. ; diameter : 3 mm.

SERIES CERITHIACEA

Family MELANIIDAE

The shell is moderately large, rounded or turretted, smooth or with varied sculpture, often truncated above, and covered with a blackish periostracum. The aperture is ovate, usually with a more or less distinct indentation or groove below. The operculum is horny, spiral, with more or less numerous whorls, sometimes wholly or partly concentric.

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Sub-family MELANATRIINAE

The shell varies in shape from a rounded to tower-shaped form, smooth or with varied sculpture, either spirally striated, ribbed or tuberculated. The columellar margin is thick, more or less arched. The aperture is usually angular below, sometimes somewhat fluted. The operculum bears more or less rapidly enlarging whorls.

Genus **Sulcospira** Troschel, 1857

The shell bears a more or less distinct spiral sculpture, and ranges from an ovately conical to a turretted shape. The columellar margin is thickened with callus deposit. The operculum bears four to six whorls.

Sub-genus **Sulcospira** s. str.

(Syn. **Acrostoma** Brot, 1871, non Le Sauvage, 1826)

The shell is spindle-shaped, with the spire moderately elevated and the walls of the whorls flattened. The aperture is distinctly angular below. Some of the largest of the freshwater molluscs are included in this sub-genus. The animals are usually found in running water.

Sulcospira (**Sulcospira**) **hügeli** (Philippi) var. **compacta** Nevill

Plate V, fig. 7

Melania (*Acrostoma*) *hügeli*, var. *compacta*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 270.
Tiara (*Acrostoma*) *hügeli*, var. *compacta*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 31.

In the typical form, *Melania* (*Acrostoma*) *hügeli*, the shell is fusiformly conical, solid, and uniformly and closely spirally striated ; the whorls are flattened and the sutures well impressed. The aperture is ovate and rather produced below, The colour of the shell is dark smoky brown.

The shell of *Melania* (*Acrostoma*) *hügeli* var. *compacta* is readily distinguished from the typical form by its shorter and stouter shape, relatively more strongly narrowed aperture and less strongly inflated but more markedly angulated body whorl and the closer and finer spiral sculpture. The spire is more truncated and the upper whorls of the spire are frequently found worn away in dead shells. The colouration is darker than in the typical form. The basal margin of the aperture is somewhat angular and markedly produced below. The outer lip is thin and sharp. The columellar margin of the aperture is whitish and polished.

Recorded localities : Wynaad, Cochin Hills and Cauvery River.

Specimens in the collection : A single dry shell, dark rufous brown in colour, from Cauvery River, with all the whorls of the spire missing except the one immediately above the body whorl and a portion of the one next above it. Measurements : Height (of the incomplete shell) : 22 mm. ; maximum diameter : 13.5 mm. ; aperture : height : 11 mm. ; diameter : 6.5 mm. These approach the type measurements cited by Preston very closely (*loc. cit.*).

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Sulcospira (Sulcospira) variabilis (Benson)[1]

Plate V, figs. 8*a* and 8*b*

Melania variabilis, Benson, Journ. Asiatic Soc. Bengal, V, 1836, p. 746.
Melania variabilis, Brot. in Martini-Chemnitz, Conc. Cab., 1875, pp. 85–87 ; pl. 10, figs. 1*a–d*.
Melania variabilis, Hanley & Theobald, Conch. Indica, 1876, p. 44 ; pl. 109, figs. 2, 3, 5 and 6.
Melania variabilis, Theobald, Cat. Shells Brit. India, 1876, p. 12.
Melania (*Melanoides*) *variabilis*, Nevill, Hand List, Moll. Ind. Mus., II, 1884, pp. 251–261.
Tiara (*Melanoides*) *variabilis*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 23.
Melania variabilis, Annandale, Rec. Ind. Mus., XIV, 1918, pp. 114, 143, 147 and 157.
Melania variabilis, Annandale & Prashad, Rec. Ind. Mus., XVI, 1919, p. 147.
Acrostoma variabile, Prashad, Rec. Ind. Mus., XXII, 1921, p. 485.
Acrostoma variabilis, Annandale & Prashad, Rec. Ind. Mus., XXII, 1921, p. 560.
Acrostoma variabile, Sewell, Rec. Ind. Mus., XXVI, 1924, p. 529 (observations on growth).

This is a common and widely distributed species with a shell which is extremely variable in its form and sculpture. Several varieties and subspecies have been described. A brief description of the typical form, which alone is represented in the Museum collection, is given below :

The shell is moderately large, and typically, it is elongated and tower-shaped, with the whorls slightly inflated. The whorls are about ten in number, and are conspicuously spirally striated and traversed by stout, evenly spaced, transpiral ribs. One of the spiral ridges just around the middle of the body whorl is particularly strongly developed ; sometimes the next spiral ridge above it is also almost equally strong and raised. The decussation of the transpiral ribs by the spiral ridges renders the former somewhat nodular in appearance. The body whorl is also rendered rather angular about the middle by the presence of the strong spiral ridge in this part. The spire is elongated and tapers gradually above, ending in a fairly sharp apex. The sutures are deeply excavated. The aperture is ovate, with a thin edged outer lip, and with the columellar margin deeply arched basally. The shell is covered by an olivaceous yellow or pale brown periostracum below which the surface layer of the shell is white. The strongest of the spiral ridges on the body whorl occurring somewhere about its middle, and its continuations as a strongly marked spiral rib close to the suture in each whorl above, are conspicuously coloured orange-red. The basal part of the body whorl surrounding the columellar border of the aperture is dark rufous brown, and the interior of the aperture is deep violet. The spiral ridges over the basal part of the body whorl adjoining the columellar border are rather strongly raised and close-set. There is considerable variation in the degree to which the spiral striae and transpiral ribs are developed.

Recorded localities : This widely distributed species was originally recorded from Goomty River at Jonpur, Tolly's Nullah, near Calcutta, but subsequently several varieties of the typical form have been recorded from various other localities. Among the more important localities cited for this species are : Calcutta, Port Canning, Kissengunj, River Hoogly, Assam, Arakan, Pegu, Bhutan, Sumatra and Manipur.

1 There has been considerable difference of opinion regarding the correct systematic position of this highly variable species. Originally described by Benson as *Melania variabilis*, it was later referred to by Preston as *Tiara* (*Melanoides*) *variabilis* in the Fauna of British India Volume on Freshwater Mollusca. Still later, Annandale & Prashad (*loc. cit.*) described it as *Acrostoma variabilis*, but as *Sulcospira* has been cited by Thiele as a synonym for *Acrostoma*, I have referred to this species as *Sulcospira* (*Sulcospira*) *variabilis* in the present paper.

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Specimens in the collection : Two dry-preserved shells, belonging to the typical form. Unfortunately, their locality is not known. The shells approach most closely the one represented by figure 5 on plate 109, in Hanley & Theobald's Conchologia Indica (1876). The shells are slightly glossy, and are covered by a pale yellowish brown periostracum which has peeled away over portions of the surface exposing the white surface layer beneath. The edge of the outer lip is somewhat broken in both the shells. Measurements (of the larger shell) : Height : 46 mm. ; maximum diameter : 15 mm. ; aperture : height : 13 mm. ; width : 9 mm.

Sub-family MELANOPSINAE

The shell is usually elongated, ovately conical, with moderately low spire, except in the genus *Faunus* in which it is high and turretted. The surface of the shell is smooth or sculptured. The columellar margin is more or less twisted. The lower margin of the aperture is usually distinctly channelled. The operculum bears an almost terminally placed nucleus.

Genus **Faunus** Montfort, 1810

(Syns. **Ebena** Schumacher, 1817 ;
Melanamona Bowdich, 1822 ;
Pirena Lamarck, 1822)

The shell is elongately turretted, acuminate, smooth, with numerous flattened whorls. The columellar margin is smooth, strongly arched and expanded into a parietal callus. The aperture is ovate, bearing an anterior canal on its basal margin.

Faunus ater (Linné)

Plate V, figs. 9*a* and 9*b*

Strombus ater, Linné, Syst. Nat., XII, p. 1213, No. 516.
Pirena atra, picta, pagodus, Reeve, Conch. Icon., XI, 1859, *Pirena*, pl. 1, figs. 3, 5 and 4.
Melanopsis atra, Deshayes, Encyclopédie Méthodique, Vers. II, p. 337, No. 11.
Pirena terebralis, Lamarck, Anim. sans vert., No. 1.
Pirena terebralis, Quoy & Gaimard, Voy. Coquille, II, p. 360.
Melanopsis princeps, Lea, Trans. Amer. Phil. Soc., V, pl. 19, fig. 74.
Faunus ater, Nevill, Hand List, Moll. Ind. Mus., II, 1884, p. 217.
Faunus ater, Preston, Fauna Brit. India, Mollusca, Gastropoda, & Pelecypoda (Freshwater), 1915, p. 9.

The shell is rather large, elongate and tapering gradually from below upwards, more or less like that of a *Turritella* or a *Terebra* in shape and proportions. The spire is long, consisting of numerous whorls and sharply acuminated towards the apex. The whorls are flattened and not inflated, and are separated by well impressed sutures. The surface of the shell is more or less regularly traversed by spiral grooves which are fairly widely spaced on the body whorl and lower whorls of the spire but become fine, numerous and close-set on the uppermost whorls of the spire. In addition to the spiral grooving there is a fine, dense, wrinkled transpiral striation throughout the surface. The aperture is small in proportion to the size of the shell, rather narrowly ovate and angular above, and is basally indented by the broad anterior canal. The columellar

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margin of the aperture is callous and deeply arched. The outer lip is sharp and thin. Fresh shells are of an intensely blackish colour but the single dry specimen from Vizagapatam in the Museum collection is bleached into an yellowish olive-brown colour. The surface is slightly glossy.

Recorded localities : Celebes, Philippines, Nicobars, Moluccas, New Ireland, Penang, Java, Timor, Buru, Amboyna, Ceylon, etc. Judging from the above range of localities, this species appears to be widely distributed, but it is rather surprising that neither Nevill nor Preston has recorded it from within Indian limits.

Specimens in the collection : A single, moderately large, dry shell in good condition, but faded into a uniform pale olive yellowish brown hue, from Vizagapatam and one dark, almost blackish brown dry shell from Cocanada. Reeve cites the number of whorls as twenty or more in his original description, but in the present specimen only eleven whorls can be made out, including the body whorl. The spiral grooving is very prominent, most of these really appearing as double spirals under the lens. Measurements : Height : 57 mm. ; maximum diameter : 15·5 mm. ; aperture : height : 16 mm. ; maximum diameter : 8 mm. The shell is apparently not a full-grown one as the measurements are considerably smaller than the typical adult measurements, cited by Preston (*loc. cit.*).

Sub-family PALUDOMINAE

The shell is rounded or ovately conical, usually without umbilicus, smooth or with spiral sculpture, with thick periostracum and a large, ovate aperture notched or obliquely grooved below.

Genus **Paludomus** Swainson, 1840

The shell is thick and solid, rounded or ovately cone-shaped, imperforate, smooth or with spiral ridges which are sometimes tuberculated or spinuous. The aperture is moderately large, ovate and sometimes angular above. The columellar margin is covered with callus and somewhat flattened. The operculum has the nucleus rather variably situated. In common with many other species of freshwater forms, the shells of this genus are almost always found more or less eroded at the apex, the shells consequently assuming a more or less Neritoid appearance.

Sub-genus **Paludomus** s. str.

The spire is conical ; the nucleus of the spirally-whorled operculum is situated near the columellar margin.

Paludomus monile Hanley

Plate V, figs. 10*a* and 10*b*

Paludomus monile (Thorpe, MSS.), Hanley & Theobald, Conch. Indica, 1876, p. 44, pl. 108, fig. 10.
Paludomus monile, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 295.
Paludomus monile, Preston, Fauna Brit. India, Mollusca Gastropoda & Pelecypoda (Freshwater), 1915, p. 48.

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The shell is moderately large, spindle-shaped and turbinated with a comparatively large and inflated body whorl, and a moderately well elevated spire. The whorls of the spire (numbering three and a half) are convex and regularly widening from above downwards. The surface of the shell is sculptured with distinct spiral grooves crossed by transpiral striae, which gives it a decussated appearance. The sutures are well impressed and are bordered below by a fine, thread-like spiral callus ridge. The aperture is ovate, more or less pear-shaped and narrowed above. The columellar margin of the aperture is thickened into a well defined, whitish callus lip. The outer lip of the aperture is thin and sharp, and bevelled inwardly towards the base. The shell is yellowish-olive, ornamented with interrupted spiral rows of reddish-purple transpirally elongated lines and bands. These colour markings are also seen on the interior through the shell.

Recorded localities : Southern India, Udamanchola, Travancore, Trivandrum.

Specimens in the collection : Two adult and full-grown shells with their spires intact and with their apices only slightly worn, from South Travancore. They are yellowish olive, bleached into white in certain portions of the surface, and purplish towards the apex. The spiral grooving is regular and distinct. The colour markings and the spiral sculpturing are particularly well marked on the whorls of the spire in the present specimens. Measurements (of the larger shell) : Height : 16 mm. ; major diameter : 12 mm. ; aperture : height : 9 mm. ; diameter : 6·5 mm. These dimensions are appreciably larger than the type measurements quoted by Preston (*loc. cit.*).

Paludomus tanschaurica Gmelin

Plate VI, figs. 1*a* and 1*b*

Paludomus tanschaurica, Gmelin, Syst. Nat., 1790, No. 3655.
Helix fluviatilis tanschaurensis, Chemnitz, Conch. Cab., IX, p. 174, fig. 1243.
Helix fluviatilis, Dillwyn, Descr. Cat. Shells, p. 959.
Paludomus Tanschaurica, Hanley & Theobald, Conch. Indica, 1876, p. 50, pl. 123, fig. 8.
Paludomus tanjoriensis, Theobald, Cat. Shells Brit. India, 1876, p. 9.
Paludomus spiralis, Reeve, Conch. Icon., III, 1847, *Paludomus*, pl. 3, fig. 15.
Paludomus tanjoriensis, H. F. Blanford, emend. Trans. Linn. Soc. London, 1863, p. 173, pl. 27, figs. 2*a–e*.
Paludomus tanjoriensis, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 294.
Paludomus tanjorica, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 39.
Paludomus tanschaurica, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 47.

Theobald, in his Catalogue of Land and Freshwater Shells of British India (*loc. cit.*) has indicated that the species described by Reeve as *Paludomus spiralis* is the same as *P. tanschaurica*, although these two names are not accepted as synonymous with each other by other authors.

The shell is moderate-sized, ovate, with a broad, inflated body whorl and a comparatively large and prominent spire. The suture is well impressed, but not margined below with callus as in the preceding species. The aperture is broadly ovate, with its columellar margin thickened by a prominent, broad, whitish callus deposit which extends above to the apex of the aperture. The outer lip is thin and sharp, and the surface of the shell smooth and glossy, but under the lens the surface is seen to be finely and closely transpirally striated throughout. The shell is pale yellowish-olive brown, ornamented with transpirally disposed undulating, dark brown or reddish brown interrupted, flame-like markings.

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Recorded localities : Poonamallee, Madras ; Tiruchirapalli, Courtalliar River, Ceylon, Southern India, Bengal and Kashmir. In and around Madras City, Ramanan (*loc. cit.*) has recorded this species from two localities, namely, the Cooum River, and in the vicinity of the Poonamallee High Road.

Specimens in the collection : Two dry shells, originally labelled *Paludomus spiralis*, from Courtalliar River. The spire is incomplete, with the apex missing in both of them. Both are smooth and glossy, but one is yellowish brown, while the other is much darker, almost horny brown. The flame-like reddish brown markings are distinct in both the shells. Measurements of the larger shell : Height : 14 mm. ; diameter : 11.5 mm. ; aperture : height : 7 mm. ; diameter : 6 mm. These measurements are slightly less than the type measurements quoted by Preston (*loc. cit.*).

Sub-genus **Stomatodon** Benson, 1862

The shell is ovately conical, with a moderately low spire, and with the aperture angular above. The columellar margin is broad and is provided with a distinct tooth towards its lower end.

This sub-genus is represented in the Museum collection by a single species, *Paludomus* (*Stomatodon*) *stomatodon* Benson, which is the type of this sub-genus. Nevill has included this species under the sub-genus *Tanalia*, which, however, is now regarded as distinct.

Paludomus (**Stomatodon**) **stomatodon** Benson

Plate VI, figs. 2*a* and 2*b*

Paludomus (*Stomatodon*) *stomatodon*, Benson, Ann. & Mag. Nat. Hist., ser. 3, Vol. X, 1862, p. 415, (as *Tanalia* ?).
Paludomus stomatodon, Hanley & Theobald, Conch. Indica, 1876, p. 44, pl. 108, fig. 1.
Paludomus (*Tanalia*) *stomatodon*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 305.
Paludomus (*Stomatodon*) *stomatodon*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 64.
Paludomus (*Stomatodon*) *stomatodon*, Thiele, Handbuch der systematischen Weichtierkunde, I, 1931, p. 196.

As pointed out by Preston (*loc. cit.*) there is a striking superficial resemblance of the shell of this species to those of *Neritina*, owing to the depressed spire, and comparatively large and inflated body whorl.

The shell is moderately large, ovately globose, solid, feebly spirally striated, the spiral striae being often almost obsolete. The spire is short and depressed, with the apex almost always eroded. There are three whorls, with the sutures well impressed. The body whorl is disproportionately large and strongly inflated. The aperture is ovate, angular above and whitish within. The white callosity on the columellar border is very broad and bears a prominent tooth-like projection towards its lower margin. The upper part of the columellar callosity is tinged blackish brown in some specimens, and a patch of the same colour may also be seen towards the base in the interior of the aperture. The operculum is horny, dark brown, excentrically nucleated and externally concave. The shell is dark olive brown or almost chestnut brown, blackish towards the spire. The outer lip is thin and sharp, but the width of the aperture is considerably reduced by the expanded columellar border.

Recorded localities : Mountain streams near Kottayam, Travancore.

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Specimens in the collection : Two dry-preserved shells with blackish spires and with their apices worn out, from Travancore. In the larger of the two, the spiral grooving on the surface is distinctly seen under the lens, and the smaller shell has the operculum intact. Measurements of the larger shell : Height : 13 mm. ; diameter : 11.5 mm. ; aperture : height : 9 mm. ; diameter (including columellar callosity) : 8.5 mm. ; width of the columellar callosity : 4.5 mm.

Sub-family MELANIINAE

The shell is imperforate, with thick periostracum, ranging from an ovately conical to an elongately turretted shape, smooth or spirally sculptured, tuberculated or spiny. The aperture is more or less elongately ovate, acutely angulated above, and usually indented below. The operculum is almost terminally nucleated.

Genus **Melania** Lamarck, 1799

The shell is of variable form and the aperture is not grooved below.

Sub-genus **Striatella** Brot, 1871

(Syn. **Melanoides** Olivier, 1804)

The shell is turretted, moderately large, with spiral striae as well as transpiral ribs.

Melania (Striatella) tuberculata (Müller)

Plate VI, figs. 3*a* and 3*b*

Nerita tuberculata, Müller, Hist. Verm., 1774, p. 191.
Melania tuberculata, Brot, *Melaniaceen*, in Martini-Chemnitz, Conch. Cab., (ed. Kuster), 1874, p. 247, pl. 26, figs. 11–11*h*.
Melania tuberculata, Hanley & Theobald, Conch. Indica, 1876, p. 32, pl. 74, figs. 1–4.
Melania tuberculata, Theobald, Cat. Shells Brit. India, 1876, p. 12.
Melania (*Striatella*) *tuberculata*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 239.
Melania tuberculata, Reeve, Conch. Icon., XII, 1860, *Melania*, pl. 13, fig. 87.
Melania tuberculata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 39.
Tiara (*Striatella*) *tuberculata*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 15.
Melania tuberculata, Annandale, Rec. Ind. Mus., XIV, 1918, pp. 114, 156 ; fig. 6 ; pl. 12, figs. 1 and 2.
Melania tuberculata, Annandale, Rec. Ind. Mus., XV, 1918, p. 163.
Melania tuberculata, Annandale & Prashad, Rec. Ind. Mus., XVI, 1919, p. 146, pl. 5, fig. 5 (radula).
Melanoides tuberculata, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1921, p. 31, pl. 4, fig. 1.
Melania tuberculata, Annandale, Rec. Ind. Mus., XIX, 1921, p. 109.
Melania tuberculata, Satyamurti, Bull. Mad. Govt. Mus., I, No. 2, Pt. 6, 1952, p. 78.

This is the most widely distributed species of this genus, and, according to Annandale (*loc. cit.*, 1921), is perhaps the most widely distributed of all the non-marine Gastropods that occur in India, for its range extends to most parts of the Oriental and Ethiopian Regions and even to part of the Palaearctic and Australasian Regions.

The shell is very variable in certain characters, especially in its size and also to a lesser degree in its shape and sculpture. Several varieties have been described, but as a rule the differences seem to be directly due to environmental factors rather than to geographical location.

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The shell is elongate, subulate and acuminated at the apex. The whorls are slightly, but distinctly, convex and very gradually and evenly increase in size from apex downwards. The whorls are evenly rounded and do not bear any angulation, shoulder or swelling, the body whorl being comparatively small in size. The aperture is rather small, narrowly ovate and somewhat contracted above, the maximum length of the aperture being much less than one-third of the total length of the shell. The shell is rather thin and sculptured with raised spiral striae and ornamented with distinct, transpiral tuberculated ridges, which are especially prominent on the whorls of the spire. The base of the body whorl bears more or less smooth spiral ridges only, the tuberculated transverse ridges being absent here. The colour of the shell is rather variable, ranging from a pale green to a dark brown or even blackish brown, but transpiral rows of reddish markings forming somewhat undulating, interrupted, flame-shaped bands are almost always present and are a characteristic feature of this species, although in some shells only faint indications of such markings may be present. The outer lip of the aperture is thin and sharp. The columellar margin of the aperture is covered with a thin callus layer. The interior of the aperture is glossy, with the external colour markings showing through. The operculum is regularly ovate, spirally whorled, bluntly angular behind and broadly rounded in front. As a rule living specimens are found in clear running water, but they also occur in stagnant ponds and are omnivorous, feeding on both vegetable and animal matter. Ramanan (*loc. cit.*) has given a good account of the breeding habits of *Melanias*.

Recorded localities : Throughout India, Burma and Ceylon ; it is one of the most widely distributed and variable species, its range extending from the southern and eastern shores of the Mediterranean, through Africa and Asia to China and North Australia. Some of the places within India from where it has been specifically recorded are as follows : Pulla River, near Cuddappah, Poona, Bangalore, Madras, Calcutta, Bombay, Rajputana, Chandernagore, Kathiawar, Bimilipatam, Raniganj, Barak River, Cachar and Roorkee, Darbund, Kutch and Mahe, and Krusadai Island in the Gulf of Manaar.

Specimens in the collection : Four rather small and comparatively slender, and one moderately large, dry-preserved shells from Madras City, one of which (among the smaller ones) appears to be a melanistic variety, being almost completely blackish ; one moderately large dry shell from Bimilipatam, rather faded ; one shell with the tubercles particularly well marked, from Cuddappah, originally labelled *Melania virgulata*, but which, on critical examination proved to be identical with *M. tuberculata* ; and several large, rufous brown spirit-preserved specimens from Bangalore at an altitude of 3,000 feet, with the reddish transpiral markings very well marked in many of the shells. Some of the large shells in the spirit collection from Bangalore are dark brown with their spiral grooves specially well marked on the body whorl. Measurements of the largest spirit-preserved specimen from Bangalore : Height : 30 mm. ; maximum diameter : 10·5 mm. ; aperture : height : 8.5 mm. ; diameter : 5 mm. Measurements of the smallest of the dry-preserved shells from Madras City : Height : 16·5 mm. ; maximum diameter : 6·5 mm. ; aperture : height : 5 mm. ; diameter : 3 mm. Unfortunately none of the shells in the collection has the operculum intact. The transpiral bands of reddish markings are particularly well seen through the thin shell in the interior of the aperture in the spirit-preserved shells from Bangalore.

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Sub-genus **Plotia** (Bolten) Röding, 1798

The shell is moderately small and thin,with fine and close-set spiral ridges and with the whorls bearing spinuous shoulder below the sutures.

Melania (Plotia) scabra (Müller)

Plate VI, figs. 4*a* and 4*b*

Buccinum scabra, Müller, Hist. Verm., II, p. 136.
Helix scabra, Chemnitz, Conch. Cab., figs. 1259 and 1260.
Bulimus scabra, Bruguière, Encyclopédia Méthodique, Vers. I, p. 330.
Melania scabra, Reeve, Conch. Icon., XII, 1860, *Melania*, pl. 26, fig. 183.
Melania scabra, Brot, *Melaniaceen*, in Martini-Chemnitz, Conch. Cab., (Ed. Küster), 1874, p. 266, figs. 14 and 15.
Melania scabra, Hanley & Theobald, Conch. Indica, 1876, p. 31, pl. 73, figs. 1–4.
Melania scabra, Theobald, Cat. Shells Brit. India, 1876, p. 12.
Melania (*Plotia*) *scabra*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 281.
Melania scabra, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 39.
Tiara (*Plotia*) *scabra*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 35.
Melania scabra, Annandale, Rec. Ind. Mus., XVI, 1919, p. 147, pl. 5, fig. 6 (radula).

The shell is ovate, rather thin and comparatively broader in proportion to the height than in *M. tuberculata*. The whorls number about seven to nine and bear an angular shoulder towards their upper part. The surface of the shell is closely spirally ridged throughout, but the ridges are rather unevenly developed, being stronger on the lower part of each whorl. Each whorl bears a row of strong, obliquely transpiral ridges which terminate above in sharp points which take the form of spinuous processes, but both the spines and the angulations are only well developed and distinct in young specimens and tend to disappear with age. In the body whorl the transpiral ridges are prominent only over the angular shoulder towards the upper part and disappear gradually towards the lower half of the shell. The aperture is ovate, rather narrowed and angular both above and below. In all dead shells collected the apices tend to be somewhat eroded. Living shells have a thick dark periostracum. The shell is typically pale brownish olive, spotted and streaked with rust-coloured transpirally disposed rows of markings. Though not as abundant as shells of *M. tuberculata*, yet living specimens have often been found in association with shells of that species in most localities.

Recorded localities : India ; Pondicherry, Madras, Poona, Coromandel, Cochin, Ceylon ; Timor, Vanikoro, Java, New Guinea, Halmaheira, Mauritius and Seychelles. This species has a wide range in India and eastwards, and has been recorded even as far east as New Guinea. Annandale has recorded it from Medha River and from Karla in the Poona District. In the Zoological Survey collection, specimens from Chaibassa, Calcutta, Chota-Nagpur, the foot of the Garo Hills, Assam, Madras, Bangalore, Nemunangad, Travancore, Simla, Matelle and Ceylon are represented. Ramanan records this species from Kandy, Balapiti and Matelle in Ceylon and from the Pennar River, Calcutta, Cuddalore, Umarkote, Barak River, Teria Ghat, Bombay, Taptie River, Poona, Cochin and Goomti River in India.

Specimens in the collection : Two dead shells, rather pale brownish, without their opercula from Cuddalore. Fully developed specimens vary considerably in their sizes according to the

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different localities from which they are collected, their heights ranging from 13 mm. to 29 mm. or even more. The Museum specimens appear to be of average size. Measurements of the larger shell : Height : 17 mm. ; diameter : 9 mm. ; aperture : height : 7 mm. ; diameter : 4 mm.

Melania (Plotia) scabra (Müller) var. **elegans** Hutton

Plate VI, figs. 5*a* and 5*b*

Melania elegans, Hutton, Journ. Asiatic Soc. Bengal, (2), XVIII, 1850, p. 658.
Melania elegans, Reeve, Conch. Icon., XII, 1860, *Melania*, pl. 26, fig. 178.
Melania scabra var. *elegans*, Hanley & Theobald, Conch. Indica, 1876, p. 31, pl. 73, figs. 5–7.
Melania elegans, Theobald, Cat. Shells Brit. India, 1876, p. 12.
Melania scabra var. *elegans*, Nevill, Hand List Moll. Ind. Mus., II, 1884, p. 284.
Melania elegans, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 39.
Tiara (*Plotia*) *scabra* var. *elegans*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 36.
Melania scabra var. *elegans*, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1921, p. 37.

By some authors this is regarded as a distinct species, but Annandale and Prashad (*loc. cit.*) are of opinion that the form *elegans* cannot be regarded as specifically distinct. This is a larger, thicker, more strongly sculptured and more brightly coloured variety of the typical form, *M. scabra*, which is thinner-shelled with well defined spines at the upper end of the transpiral ribs on the body whorl, and is the usual form reported to be common in Southern India.

The shell of *Melania scabra* var. *elegans* is rather solid, thick-walled, ovately turretted, and bearing about seven to eight whorls. The whorls are strongly and angularly shouldered round their upper parts. The surface of the shell is closely and finely spirally ridged throughout and in addition to these there are strong transpiral ribs which are tuberculated, the tubercles at the angular shoulders on the whorls being specially prominent and well developed ; the angular shoulders sometimes even bear spinuous processes, but these are mostly absent especially in adult shells as they are easily worn away. The aperture is rather small, narrowly ovate and slightly sinuated at the upper part. The columellar margin of the aperture is smooth, white and polished. The shell is variable in colour, ranging from yellowish green to a pale sandy brown, finely dotted and transpirally banded with elegant, interrupted, reddish flame-like markings. In fresh living shells, a thin, pale greyish periostracum is present. The shell of this variety grows to a larger size than that of the typical form, *M. scabra s.* str.

Recorded localities : Rivers Gumti, Belwa and Cen ; Ferozepore, the Bolan Pass, the Sunderbunds (in West Bengal), the north of Oudh and many localities in Southern India ; Afghanistan. Annandale and Prashad have recorded it from the inland waters of Baluchistan and of Seistan. Ramanan has recorded it from Madras as *M. elegans*.

Specimens in the collection : Two dead shells from Madras City, one of them badly worn with the columella partly exposed and the other with the operculum intact. Both are partly bleached and of a pale, sandy brown colour. The aperture is narrowly ovate with its bevelled edge sloping

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inwards basally. The operculum is ovate and horny, dark brown, pointed posteriorly and closely striated externally. Measurements of the larger shell : Height : 21 mm. ; diameter : 9 mm ; aperture : height : 7·5 mm. ; diameter : 4 mm.

Family CERITHIIDAE

This family includes forms with small to considerably large shells—popularly known as horn shells. The shell is usually tower-shaped, often with distinct sculpture in the form of tuberculated ridges. An anterior canal is present, but short and sometimes reduced. The operculum is horny, spirally whorled and excentrically nucleated. The vast majority of species included in this family are marine or backwater forms.

Sub-family LITIOPINAE

The shell is small, thin-walled, elongate and ovately conical, with a sharp apex, and usually with feeble sculpture or smooth. The aperture is ovate, with the columellar margin either simple or truncated below. The operculum is thin, with an internal curved ridge near the nucleus.

Genus **Litiopa** Rang, 1829

(Syn. **Bombyxinus** Belanger, 1834)

The shell is elongate and ovately conical, with the embryonic shell ribbed. The succeeding whorls are inflated and more or less distinctly spirally grooved and usually also transpirally ribbed. The aperture is elongately ovate. The columellar margin is angular below.

Litiopa kempi Preston[1]

Plate VI, figs. 6*a* and 6*b*

Litiopa (*Alaba*) *kempi*, Preston, Rec. Ind. Mus., X, 1914, p. 300 ; figs. 3 and 3*a*, p. 298.
Litiopa (*Alaba*) *kempi*, Preston, Rec. Ind. Mus., XI, 1915, p. 292.

The shell is elongately fusiform, without an umbilicus. Dead shells are whitish, but traces of a reddish brown periostracum can be made out in fresh specimens. The adult shell bears six whorls, sculptured with coarse transpiral ribs and spiral grooves. These spiral grooves are particularly prominent on the lower half of the body whorl. In addition to these, microscopic confluent striae are discernable under the lens. The sutures are well impressed and the base of the shell is finely spirally striated. The aperture is ovate, with a thin, sharp-edged outer lip, and the columellar margin is oblique and slightly arched.

[1] Preston, while describing this as a new species (*loc. cit.*) has referred it to the subgenus *Alaba*, under the genus *Litiopa*. But Thiele has treated *Alaba* H. & A. Adams, as a separate genus, and as we have followed Thiele's classification in the present paper, the species has been designated here simply as *Litiopa kempi* and not as *Litiopa* (*Alaba*) *kempi*.

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Recorded localities : Rambha Bay, south end of Chilka Lake, Ganjam District, Orissa ; 8 miles south-west of Breakfast Island ; 1 mile east of Chirya Island ; Nalbhano, Mahosa, Berhampur Island, Ganjam District, Orissa. Living shells have been collected from among grass-like weeds on sandy bottom in shallow water close to the shore of Barkuda Island.

Specimens in the collection : A single dry-preserved empty shell, completely white, from Chilka Lake, Orissa. The transpiral ribs are distinct and the spiral striae are prominent only on the lower half of the whorls. Measurements : Height : 8 mm. ; maximum diameter : 3 mm. ; aperture : height : 2 mm. ; diameter : 1·5 mm. These measurements are considerably larger than the type measurements cited by Preston (*loc. cit.*).

SUB-CLASS PULMONATA

Order BASOMMATOPHORA

SERIES HYGROPHILA

Family LYMNAEIDAE

The shell is usually dextral, very rarely sinistral, with more or less elevated spire, thin, and with the aperture of variable width.

Sub-family LYMNAEINAE

The shell is ovate or fusiform, with exserted, or more or less depressed spire, and spirally whorled.

Genus **Lymnaea** Lamarck, 1799

(Syn. **Lymnus** Montfort, 1810 ;

Lymnula Refinesque, 1819 ;

Leachia Jeffreys, 1833).

The shell is not covered by the mantle and the spire is almost always exserted and acuminated with a sharply pointed apex. The columella is spirally twisted. An operculum is absent.

This is a genus of common, thin-shelled freshwater snails of world-wide distribution. The animals inhabit sluggish ponds and pools abounding in aquatic vegetation, and are gregarious in habit.

Five species are represented in the Museum collection, of which two are European species, namely, *L stagnalis* and *L. auricularia*, ranging as far east as Afghanistan and Kashmir, but not recorded from the rest of India. The shell is extraordinarily variable in *Lymnaea*, and it is therefore important that the soft parts should be examined wherever possible in determining the species of this genus.

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Lymnaea acuminata Lamarck

Plate VI, figs. 7*a* and 7*b*

Limnaea acuminata, Lamarck, Anim. sans vert., VI, pt. 2, p. 160.
Limnaea acuminata, Sowerby, in Reeve, Conch. Icon., XVIII, 1873, *Limnaea*, pl. 10, fig. 66.
Limnaea acuminata, Hanley & Theobald, Conch. Indica, 1876, p. 30, pl. 70, figs. 8 and 9.
Limnaea acuminata, Theobald, Cat. Shells Brit. India, 1876, p. 34.
Limnaeus acuminatus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 233.
Limnaea acuminata var. *patula* and *rufescens*, von Martens, Conch. Mitth., I, 1890, pp. 75 and 76 ; pl. 14, figs. 1–3.
Limnaea acuminata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Limnaea (*Limnaea*) *acuminata*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 106.
Limnaea (*Limnaea*) *acuminata*, Preston, Rec. Ind. Mus., VIII, 1915, p. 539.
Limnaea acuminata, Annandale, Rec. Ind. Mus., XIV, 1918, pp. 110, 151–153.
Limnaea acuminata, Annandale, Rec. Ind. Mus., XVI, 1919, pp. 140, 142–144.
Limnaea acuminata, Annandale & Prashad, Rec. Ind. Mus., XXII, 1921, p. 568, pl. 7, figs. 1–3.
Limnaea acuminata, Prashad, Rec. Ind. Mus., XXIV, 1922, p. 13.
Limnaea acuminata, Annandale & Rao, Rec. Ind. Mus., XXV, 1923, p. 396.
Limnaea acuminata, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, p. 177.

The shell is thin, oblong-ovate, smooth, glossy externally, and somewhat semi-translucent. The body whorl is inflated and slightly angular above. The spire is short, narrow, with the whorls attenuated, terminating in a sharply exserted spire and acuminated apex above. The aperture is large and considerably wide and open. The columellar lip of the aperture is spirally twisted. Shells of this species are extremely variable especially in the proportions of the breadth to the height of the body whorl and consequently a number of varieties have been distinguished and described by various authors, many of which are but local variations of the type and not of much systematic value. Living specimens inhabit pools and ponds generally containing plenty of aquatic vegetation. Ramanan (*loc. cit.*) has given a good account of the habits of the animals of this and the succeeding South Indian species, while Annandale (*loc. cit.*, 1919), has described in detail the soft parts and radula of this species.

Recorded localities : This is a widely distributed species recorded from Bengal, Bihar, Sind, Bombay, Roorkee, Rajputana, Mussoree, Nagpur, Streeperambatoor in Southern India, and various other localities in India as well as in Burma.

Specimens in the collection : Two dead shells, both somewhat damaged, from Streeperambatoor and three adult and five young spirit-preserved specimens with their soft parts intact, from Bangalore (altitude 3,000 feet). The shells are all white, semipellucid, with the soft parts showing through the shells. The surface of the shell is finely and closely transpirally striated in all the specimens. Young shells are thinner and more translucent than the adult ones. The main feature of the shell of this species which distinguishes it from that of *L. luteola* and *L. pinguis* is the rather abruptly narrowed base of the spire, resulting in a more or less strong demarcation between the body whorl and the spire, and this feature is well marked in all the specimens examined. Average measurements of the adult shell : Height : 24 mm. ; maximum diameter : 12 mm. ; aperture : height : 16 mm. ; maximum diameter : 7·5 mm.

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Lymnaea luteola Lamarck

Plate VI, figs. 8*a* and 8*b*

Lymnaea luteola, Lamarck, Anim. sans vert., VI, pt. 2, p. 160.
Lymnaea luteola, Lamarck, Proc. Zool. Soc. London, 1856, p. 186.
Limnaeus cerasum, Troschel, in Wiegmann's Archiv. fur Naturg., III, 1837, p. 170.
Limnaea luteola, Sowerby, in Reeve, Conch. Icon., XVIII, 1873, *Limnaea*, pl. 15, fig. 104.
Limnaea ovalis, Sowerby, in Reeve, Ibid., pl. 9, fig. 59.
Limnaea luteola, Hanley & Theobald, Conch. Indica, 1876, p. 30, pl. 70, figs. 5 and 6.
Limnaea luteola, Theobald, Cat. Shells Brit. India, 1876, p. 34.
Limnaeus luteolus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 232.
Lymnaea luteola, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Limnaea (*Limnaea*) *acuminata* var. *cerasum*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 108.
Limnaea luteola, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, pp. 106 and 183.
Limnaea luteola, Annandale, Ind. Journ. Med. Res., VIII, 1920, p. 109.
Limnaea luteola, Prashad, Rec. Ind. Mus., XXIV, 1922, p. 14.
Limnaea luteola, Annandale & Rao, Rec. Ind. Mus., XXV, 1923, p. 396.

Nevill (*loc. cit.*) quotes *L. succineus* Deshayes, as a synonym for this, but Annandale and Rao (*loc. cit.*) regard this as a distinct form of *L. luteola*. The shell is thin, rather broadly ovate, with a large, inflated body whorl which is rather broad anteriorly, and a comparatively short and broadly conical spire. The shell is much broader in proportion to its height than in the preceding species, and the base of the spire is comparatively broad so that the transition between the body whorl and the spire is more gradual and even in this species than in the preceding one. The whorls of the spire are few in number, and are slightly, but distinctly inflated. The apex is sharp and pointed. The aperture is usually narrow, ovate, rather stongly narrowed and angular above but evenly rounded anteriorly. The columellar lip of the aperture bears a strong spiral fold. The shell is smooth and semi-translucent with a slight, pale horny yellow tinge. The apex of the spire is brownish. Fine and close-set transpiral striae may be observed on the surface of the shell under the lens. The columellar fold is opaque white.

Recorded localities: Bangalore, Coonoor, Tiruchirapalli, Madras, Naini Tal, Calcutta, Bengal, Hawelbagh, Kutch, Roorkee, Raneegunge, Mussooree, Manbhoom, Bombay, Deccan.

Specimens in the collections: Several dry shells from Madras, one dry shell from Cochin, and two series, each consisting of several spirit-preserved specimens (young as well as adult) with their soft parts intact ; one of these spirit-preserved series is from Bangalore (altitude 3,000 feet). The shells are pale, almost whitish and the adult ones reach a larger size than the biggest specimens in the other series. The second series is collected from Ennur (near the level crossing) in Chingleput District. These shells are darker, being brownish, (some of them even of a smoky or blakish brown colour. The spire in some of these shells is much shorter and more broadened at the base, compared to the shells in the Bangalore series. Average measurements of the adult shells : Height : 20 mm. ; maximum diameter : 14 mm. ; aperture : height : 14·5 mm. ; maximum diameter : 8 mm. The shell being so thin and delicate, the edge of the outer lip is often found broken even in specimens otherwise well preserved in spirit.

The dry-preserved shells in the collection are of a dirty white colour, and some of them are dull greyish brown. There is considerable variation in the proportion of the width to the height of the shell in this species.

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Lymnaea pinguis Dohrn

Plate VII, figs. 1*a* and 1*b*

Limnaea pinguis, Dohrn, Proc. Zool. Soc. London, 1858, p. 124.
Limnaea succinea, Reeve, Conch. Icon., XVIII, 1873, *Limnaea*, pl. 4, fig. 26.
Limnaea pinguis, Hanley & Theobald, Conch. Indica, 1876, p. 30, pl. 70, figs. 7, 8 and 10.
Limnaea pinguis, Theobald, Cat. Shells Brit. India, 1876, p. 34.
Limnaeus luteolus var. *pinguis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 233.
Lymnaea pinguis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Limnaea (*Gulnaria*) *pinguis*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 113.
Limnaea pinguis, Annandale, Rec. Ind. Mus., XVI, 1919, p. 144.

Annandale (*loc. cit.*) is of opinion that this species may prove to be synonymous with *L. succinea* of Deshayes. The shell is more or less broadly spindle-shaped, but definitely narrower at the middle in proportion to the height than in the preceding species. It is ovately acuminated, and very thin, pale horny brown and semi-translucent, with the soft parts showing through the shell. The surface of the shell is very finely and closely transpirally striated. The whorls are four in number and rather concave. The spire is distinctly elevated, with an acute apex, but rather short and conical. The two uppermost whorls of the spire are very small, the one next below them somewhat larger and the body whorl comparatively very large, inflated and ovate, being nearly two-thirds of the total length of the shell. The aperture is oblique and oblong-ovate, with a thin outer lip, and with the columellar margin reflected out and bearing a thin layer of callus. Annandale (*loc, cit.*) has described the radula and genitalia of this species, while Ramanan (*loc. cit.*) has given a brief account of the habits of this species which are very similar to those of *L. luteola*. Although Ramanan has treated this species (*L. pinguis*) as a separate species, he admits that it is probable that this may prove to be only a variety of *L. luteola* as considered by Nevill (*loc. cit.*) and Blanford. But the shell of *L. pinguis* appears to be smaller in average size than that of *L. luteola*, the largest specimen of *L. pinguis* (at least from the Madras area), never exceeding a moderate-sized one of *L. luteola*, while the majority are distinctly smaller.

Recorded localities : Ceylon ; Kandy, Galle, Ceylon ; Bengal (Calcutta) ; Bombay and Madras. Ramanan (*loc. cit.*) appears to have recorded it for the first time from Madras in 1900. Even in Madras, it is reported to occur only at one spot, namely, Kariankuttai, in Choolai.

Specimens in the collection : Four moderate-sized spirit-preserved specimens, with the soft parts intact, from Horsleykonda (altitude 3,000—4,100 feet) in the Chittoor District (one of which is in a damaged condition). The shells appear dark greyish brown in colour, but much of this colour is due to the black soft parts showing through the thin, semitranslucent, pale dirty white or horny brown shells. Measurements of the largest of the four shells : Height : 14 mm. ; maximum diameter : 8 mm. ; aperture : height : 7·5 mm. ; maximum diameter : 4 mm. These measurements are considerably smaller than those of a specimen from Bombay streams recorded by Annandale (*loc. cit.*) and also somewhat smaller than those of the type measurements cited by Preston (*loc. cit*).

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Lymnaea stagnalis (Linné)

Plate VII, figs. 2*a* and 2*b*

Helix stagnalis and H. fragilis, Linné, Syst. Nat., Ed. X, 1758, p. 774.
Lymnaea stagnalis, Lamarck, Anim. sans vert., 1801, p. 91.
Lymnaea stagnalis, Lamarck, Proc. Zool. Soc. London, 1856, p. 186.
Limnaea stagnalis, Sowerby, in Reeve, Conch. Icon., XVIII, 1873, *Limnaea*, pl. 1, fig. 4.
Limnaea stagnalis, Hanley & Theobald, Conch. Indica, 1876, p. xvi.
Limnaea stagnalis, Theobald, Cat. Shells Brit. India, 1876, p. 34.
Limnaeus stagnalis, Nevill, Hand List, Moll. Ind. Mus., I, 1878, p. 235.
Limnaea stagnalis, Rimmer, Land & Freshwater Shells of the British Isles, 1907, p. 62.
Limnaea stagnalis, Preston, Rec. Ind. Mus., II, 1908, p. 108.
Limnaea stagnalis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 106.
Limnaea stagnalis, Annandale, Rec. Ind. Mus., XV, 1918, p. 165.
Limnaea stagnalis, Annandale, Ibid., XVIII, 1919–1921, pp. 20 and 246.
Limnaea stagnalis, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, p. 147.

This is a well-known and widely distributed Eurasian species, ranging in its distribution all over Europe and as far east as Afghanistan and Kashmir where it is reported to be common at moderate altitudes.

The shell is much larger than in all other species of *Limnaea*—recorded in this paper. It is rather thin, elongated and ovately turretted. The spire is strongly elevated and attenuated towards the apex. Its base is considerably narrower than the upper end of the body whorl and hence there is rather an abrupt demarcation between the body whorl and the spire somewhat as in *L. acuminata*, but in the present species the spire is considerably more elevated, being almost as high as the body whorl. The whorls, numbering about five to six, are somewhat convex and sloping steeply round their upper parts ; the body whorl is rather strongly inflated and elongately ovate. The aperture is large, elongated and somewhat squarely ovate, and the columellar lip of the aperture is more or less expanded, thickened with callus and spirally twisted. The shell is pale horny yellow or fulvous, smooth and glossy and seen to be very finely and closely transpirally striated throughout the surface on close examination under the lens.

Recorded localities : Europe (France, Germany and England) ; Afghanistan, Kashmir, Srinagar. Kashmir is the only place whence this species has been recorded in India.

Specimens in the collection : One dry-preserved shell in fairly good condition from Dalmatia. It is almost pure white and highly glossy. The edge of the outer lip and tip of the apex are slightly broken, these parts being very thin and delicate. Measurements : Height : 41·5 mm ; maximum diameter : 18 mm. ; aperture : height : 20 mm. ; maximum diameter : 10·5 mm.

Lymnaea auricularia (Draparnaud)

Plate VII, figs. 3*a* and 3*b*

Lymnaeus auricularius, Draparnaud, Tabl. Moll., 1801, p. 48.
Helix auricularia, Linné, Syst. Nat. Ed. X, 1758, p. 774.
Limnaea auricularia, Reeve, Conch. Icon., XVIII, 1873, *Limnaea*, pl. 1, fig. 1.
Limnaea auricularia, Hanley & Theobald, Conch. Indica, 1876, p. xvi.
Limnaeus auricularia, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 238.
Limnaea auricularia, Rimmer, Land and Freshwater Shells of the British Isles, 1907, p. 61.
Limnaea (Gulnaria) auricularia, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 111.
Limnaea auricularia, Preston, Rec. Ind. Mus., III, 1909, p. 115.
Limnaea auricularia, Annandale, Rec. Ind. Mus., XIV, 1918, pp. 151–153.
Limnaea auricularia, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1921, pp. 39, 41, 43, 104 and 113.
Limnaea auricularia, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, p. 158.

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Like the preceding species, this is a European species, but recorded also from Afghanistan and Kashmir. The shell is thin and somewhat squarely ovoid, smooth, glossy and pale horny yellow in colour. The spire is conical, with a sharply pointed apex, and very small in proportion to the body whorl from which it is sharply demarcated. The body whorl is rather abruptly enlarged and widely inflated somewhat as in *L. acuminata*. The shell of *L. auricularia* is readily distinguished from those of all the true Indian forms of the genus by its short acuminated spire and very oblique and greatly inflated body whorl. The whorls of the spire number about three to four, and are convex, rapidly increasing in size from above downwards. The surface of the shell is finely and closely transpirally striated throughout. The aperture is very large and broad, the outer lip being thin and rather expanded. The columellar lip of the aperture is covered with a callus layer, and is spirally twisted and dilated over the narrow umbilicus. The shell is likely to be confused with those of two related species found with it in Kashmir, *viz.*, *L. lagotis* and *L. brevicula*, but the suture is linear in *L. auricularia* and not broad as in the other two species.

Recorded localities : Europe : Britain, Ireland, Berlin and Austria ; India : Kashmir ; Afghanistan.

Specimens in the collection : Two dry-preserved shells, with their locality labelled as " Europe ". They are highly glossy and almost white, except over the spire and towards the apex where they are pale horny brown. Measurements of the larger shell : Height : 19 mm. ; maximum diameter : 12 mm. ; aperture : height : 14 mm. ; maximum diameter: 8 mm. The specimens do not appear to be full-grown shells as these measurements are considerably smaller, being less than two-thirds of the type measurements cited by Preston (*loc. cit.*). It is interesting to note that many of the species of *Lymnaea* recorded from Kashmir occur also in Europe and are more closely related to European forms than to Indian species occurring over the rest of the country.

Family PLANORBIDAE

The shell is sometimes sinistral and sometimes dextral ; the spire is sometimes elevated, but more often depressed, the shell being disc-shaped and flattened. This family includes freshwater snails inhabiting sluggish streams or stagnant pools, often found attached to aquatic plants.

Genus **Planorbis** O.F. Müller, 1774

The shell is usually moderately large, more or less shaped like a thick disc, with the whorls arranged almost in one horizontal plane, with the left-handed aperture sometimes flattened above. The shell often has the spire depressed or sunk inwards, and on the underside there is usually a more or less deep umbilicus. The aperture is generally broad, ovate, semilunar or triangular.

L. Germain, in his ' Catalogue of Planorbidae ' (*Rec. Ind. Mus.*, XXI, 1921) has defined the sub-genus *Planorbis* s. str. as follows and has assigned the common species *exustus* to this sub-genus :—

" The shell is moderately large, discoidal, and depressed both above and below. The spire is composed of only a few whorls, normally rounded both above and below. The aperture is sub-ovate."

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But later, Annandale and Prashad (1920) created the new genus *Indoplanorbis* for the reception of this species, which is therefore referred to under this name in the present paper. I have, however, treated it as a sub-genus, following Thiele whose classification has been adopted in the present account.

Sub-genus **Indoplanorbis** Annandale & Prashad, 1920

The shell is relatively large and thick, and discoidal, but the whorls are convex and the suture deeply impressed. The aperture is ear-shaped, with the broader end uppermost when the shell is viewed with the aperture on the left. The young shell is *Physa*-like in appearance. The branchial process is distinctly lobed, the radula is rather large and broad and the penis long and cylindrically tubular.

Planorbis (*Indoplanorbis*) *exustus*, which is the only species referable to this sub-genus recorded in India, is the type of this sub-genus, and is represented in the Museum collection by several spirit-preserved specimens.

Planorbis (**Indoplanorbis**) **exustus** (Deshayes)

Plate VII, figs. 4*a* to 4*c*

Planorbis exustus, Deshayes, Voyage Belanger Indes Orientales Zoologie, 1834, p. 417, pl. 1, figs. 11–13.
Planorbis indicus, Benson, Journ. Asiatic Soc. Bengal, V, 1836, p. 743.
Planorbis brunneus, Gray, in Adams, Genera of Recent Mollusca, II, 1855, p. 261 (non Lister).
Planorbis coromandelicus, Martens, Proc. Zool. Soc. London, 1860, p. 12.
Planorbis circumspissus, Crosse & Fischer, Journ. de Conchyl., XI, 1863, p. 362.
Planorbis exustus, Crosse & Fischer, Journ. de Conchyl., XXIV, 1876, p. 315.
Planorbis zebrinus, *exustus* and *Merguiensis*, Hanley & Theobald, Conch. Indica, 1876, pp. xviii, 18 and 60 ; pl. 39, fig. 10 ; pl. 40, fig. 1 and pl. 151, figs. 5–6.
Planorbis exustus, *coromandelicus*, *brunneus* and *Merguiensis*, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Planorbis*, pl. 4, figs. 31 and 34 ; pl. 5, figs. 38*a–c*, and 40*a* and *b* ; and pl. 11, fig. 85.
Planorbis exustus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 241.
Planorbis exustus, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Planorbis exustus, Blanford, Proc. Malacol. Soc. London, 1903, p. 280.
Planorbis exustus, Dautzenberg & Fischer, Journ. de Conchyl., LII, 1905, p. 381.
Planorbis exustus, Bavay & Dautzenberg, Journ. de Conchyl., LVIII, 1910, p. 18.
Planorbis exustus, *zebrinus*, *merguiensis*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 115, 116 and 118.
Planorbis exustus, Annandale, Rec. Ind. Mus., XIV, 1918, pp. 111 and 145.
Planorbis (*Planorbis*) *exustus*, Germain, Rec. Ind. Mus., XXI, 1921–24, p. 26.
Indoplanorbis exustus, Prashad, Rec. Ind. Mus., XXII, 1921, p. 472.
Indoplanorbis exustus, Rao, Rec. Ind. Mus., XXV, 1923, pp. 199–219 ; text figs. 1–14 (anatomy).
Indoplanorbis exustus, Annandale & Rao, Rec. Ind. Mus., XXV, 1923, p. 396.
Indoplanorbis exustus, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, p. 108.

This is perhaps the commonest species of Planorbidae occurring in India, and is also the largest Planorbid known in India. It is widely distributed in the Oriental Region, and the remarkable range of variation exhibited by this species in the form of its spire, aperture, the size of the shell and its colour and sculpture has been responsible for the large number of synonymous names by which this species has been known to various authors. The shell is moderately large,

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fairly thick, depressed, discoidal, sinistral and more or less concavely flattened on both sides. The spire is deeply depressed and actually sunk below the level of the body whorl which is somewhat expanded towards the aperture. The whorls are convex, three in number and spirally coiled in one horizontal plane, the body whorl being much larger and more strongly inflated than the comparatively small and compressed whorls of the spire. The under side of the shell is broadly concave, the umbilicus being widely open and exposing the lower surfaces of the whorls of the spire. The aperture is wide and ear-shaped, somewhat inclined upwards, its outline being broadly rounded above and more or less straight and horizontally flattened below, the lip being rendered markedly angular below just before it meets the body whorl on the lower side. The edge of the lip of the aperture is somewhat reflected outwards and is usually more or less thickened in full-grown shells.

The surface of the shell is finely transpirally ridged throughout. The shell is greenish brown, but there is considerable variation in colour, some shells being chestnut or almost rufous brown while others are dull greyish black tinged with green. The soft parts are intact in most of the specimens represented in the Museum collection. The body is of an olive-black colour, with slender, translucent greenish black tentacles, large, black, rounded eyes and a dark purplish grey foot, finely spotted with black. Living specimens inhabit sluggish streams, stagnant ponds or marshes and often attach themselves to aquatic plants. The living animal usually carries the shell with the wider end of the aperture on its right side ; in this position the upper part of the shell (*i.e.*, the flattened spire) is on the left side of the animal. Ramanan (*loc. cit.*) has given an account of the soft parts and habits of the animals of this and the succeeding species and Rao (*loc. cit.*) has described in detail the anatomy of this species.

Recorded localities : This species has been recorded from a very wide range of localities. Nevil, (*loc. cit.*) gives a long list of localities for the Indian Museum specimens. The more important among the localities from which this species has been recorded are : Kandy, Balapiti, Calcutta, Port Canning, West of Indore, Bangalore, Puri, Bombay, Gauhati, Mussooree, Manbhum, Roorkee, Patna, Salt Range and many other places in India and Ceylon. Also Damotha, Moulmein, Mandalay and Bhamo in Burma, Cochin-China and Deli in Sumatra.

Specimens in the collection : A large number of spirit-preserved specimens with their soft parts intact, from Bangalore, at an altitude of 3,000 feet, and nine spirit-preserved specimens, but with rather contracted soft parts from Conjeevaram in the Chingleput District. The latter lot are greenish grey, but among the Bangalore specimens a good number of shells are rufous or chestnut brown at least over portions of the surface. Measurements: (of the largest specimen from Bangalore) : Diameter : major : 17 mm. ; minor : 13.5 mm. ; height : 9 mm. ; aperture : height : 7 mm. ; width : 5.5. mm. The specimens collected from Conjeevaram are smaller than the above shell from Bangalore.

Genus **Anisus** Studer, 1820

The shell is usually small and depressed, sometimes keeled, with the spire and umbilicus somewhat sunk inwards, resulting in the shell being shaped more or less in the form of a biconcave disc. The aperture is more or less narrow.

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Sub-genus **Diplodiscus** Westerlund, 1897

[Syn. **Spiralina** (Hartmann) Martens, 1899]

The shell is strongly depressed, discoidal, keeled, with the whorls very gradually increasing in size from the apex outwards. The aperture is small.

Anisus (Diplodiscus) hyptiocyclos (Benson)

Plate VII, figs. 5*a* and 5*b*

Helix hyptiocyclos, Benson, Ann. & Mag. Nat. Hist., ser. 3, XI, 1863, p. 89.
Helix hyptiocyclos, Pfeiffer, Mon. Helic., V, p. 117.
Planorbis hyptiocyclos, Hanley & Theobald, Conch. Indica, 1876, p. 40, pl. 99, figs. 5–7.
Planorbis hyptiocyclos, Theobald, Cat. Shells Brit. India, 1876, p. 35.
Planorbis (*Nautilina*) *hyptiocyclos*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 245.
Planorbis hyptiocyclos, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Planorbis*, pl. 14, fig. 120.
Planorbis hyptiocyclos, Clessin, in Martini-Chemnitz, Conchyl. Cabin., 2nd Ed., XVII, 1886, p. 228.
Planorbis hyptiocyclos, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Planorbis (? *Gyraulus*) *hyptiocyclos*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 123.

The shell is small, depressed, dextral, discoidal and widely umbilicated, with the spire somewhat sunk inwards. It is thin, translucent, glossy and olivaceous horny in colour, with the surface finely and obliquely transpirally striated. The spire is concavely depressed and the sutures are deeply impressed. There are four whorls, gradually increasing in size from the apex outwards, and convexly inflated. The body whorl is convex, slightly expanded towards the apertural end and distinctly keeled round the periphery. The aperture is oblique and more or less semi-circular or D-shaped in outline, the peristome being thin, sharp and somewhat raised above the sutural level where it meets the columellar surface which is covered with a thin callus layer. The lower, umbilical surface is broadly depressed and concave.

Recorded localities : Ceylon ; Fort Mac Donald, Ceylon (Province of Uva) ; Balapiti, Ceylon. Ramanan (*loc. cit.*) recorded it for the first time from Madras in 1900, but since then there does not appear to have been any subsequent record of this species from Madras.

Specimens in the collection : A single dry-preserved shell, glossy and dull olive-horny brown in colour, from Madras. Remnants of a dark greenish black periostracum persist as blotched markings on the upper surface and there is a distinct dark double spiral band on the periphery of the body whorl just below the keel running from the columellar end up to about half way round the body whorl. Measurements : Diameter : major : 6 mm. ; minor : 5 mm. ; height : 1.75 mm. These dimensions are almost exactly identical with those of the type cited by Preston (*loc. cit.*).

Sub-genus **Gyraulus** (L. Agassiz) Charpentier, 1837

The shell is small and depressed, with the whorls rounded and rapidly increasing in size from the apex outwards. In the typical forms the aperture is moderately wide, and broader than high.

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Anisus (Gyraulus) convexiusculus (Hutton)

Plate VII, figs. 6*a* and 6*b*

Planorbis convexiusculus, Hutton, Journ. Asiatic Soc. Bengal, XVIII, pt. ii, 1849, p. 657.
Planorbis convexiusculus, Hanley & Theobald, Conch. Indica, 1876, pp. xviii and 40 ; pl. 99, figs. 8–10.
Planorbis convexiusculus, Theobald, Cat. Shells, Brit. India, 1876, p. 35.
Planorbis convexiusculus, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Planorbis*, pl. 11, figs. 93*a* and *b*.
Planorbis (*Nautilina*) *convexiusculus*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 244.
Planorbis convexiusculus, Clessin, in Martini-Chemnitz, Conchyl. Cabin., 2nd Ed., XVII, 1886, p. 127, No. 98, pl. 17, fig. 9.
Planorbis (*Gyraulus*) *convexiusculus*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater) 1915, p. 118.
Planorbis saigonensis (?), Annandale, Rec. Ind. Mus., XIV, 1918, p. 112, pl. 11, fig. 12.
Planorbis convexiusculus, Annandale, Rec. Ind. Mus., XV, 1918, p. 166.
Gyraulus convexiusculus, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1919, pp. 52–54, figs. 5*E*, 7*a* and 8*b*.
Planorbis (*Gyraulus*) *convexiusculus*, Germain, Rec. Ind. Mus., XXI, 1921–24, p. 120.
Gyraulus convexiusculus, Annandale & Prashad, Rec. Ind. Mus., XXII, 1921, p. 582.
Gyraulus convexiusculus, Prashad, Rec. Ind. Mus., XXIV, 1922, p. 15.
Gyraulus convexiusculus, Annandale & Rao, Rec. Ind. Mus., XXV, 1923, p. 397.
Gyraulus convexiusculus, Annandale & Rao, Rec. Ind. Mus., XXVII, 1925, p. 108.

The shell is very small, barely exceeding $\frac{1}{4}$ inch in diameter, and strongly depressed and discoidal. The surface of the shell is more or less glossy, and when examined under the lens, is observed to be closely and finely, obliquely transpirally striated. The whorls number four to five and are well rounded. The sutures are well defined and depressed. The shell is dextral, the aperture being placed on the right side. The aperture is oblique and ovately lunate, with a thin outer lip which is evenly rounded in outline without any angulation in the middle, although the periphery of the body whorl is subangulate. The umbilicus is wide and deep, exposing the under surface of the successive whorls to view when the shell is seen from below. The shell is pale horny brown in colour. The shell of this species differs from that of *Planorbis* (*Gyraulus*) *saigonensis* in the absence of the delicate keel at the peripheral border of the body whorl, in the aperture being devoid of the angle at the middle of the outer lip and in the whorls being more strongly convex, rounded and more openly wound. The animal is blackish or dusky brown in colour. Living specimens are common in tanks, marshes and along the marshy banks of rivers in the localities from which they have been recorded.

Recorded localities : Kandahar, Quettah and the Kojuck Pass, along marshlands of the River Helmund at Girishk, Gangetic Provinces, Pinjore, below Simla ; Moradabad, Birbhum ; Manipur Valley and Kangra District, Assam, Doorgaon, Umbala, Parisnath, Manbhum, Orissa, Calcutta, Chandernagore and Port Canning ; Salt Range, Punjab. This species is widely distributed in the Oriental Region and has also been recorded from Afghanistan, Andaman Islands and China.

Specimens in the collection : Two dry-preserved shells from Madras. They are glossy and of a very pale horny brown colour, and minutely transpirally striated on the surface. One is slightly larger than the other. Measurements of the larger specimen : Diameter : major : 4.5 mm. ; minor : 3 mm. ; height : 2 mm.

It seems rather strange that this species, although common and widely distributed, had not been previously recorded from Madras, and Ramanan has not mentioned it either, in his paper on the Non-marine Mollusca of Madras and its vicinity (1900).

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Anisus (Gyraulus) saigonensis (Crosse & Fischer)

Plate VII, figs, 7*a* to 7*c*

Planorbis compressus, Hutton, Journ. Asiatic Soc. Bengal, III, 1834, p. 93 (non Michaud).
Planorbis compressus, Benson, Journ. Asiatic Soc. Bengal, V, 1836, p. 743.
Planorbis saigonensis, Crosse et Fisher, Journ. de Conchyl., XI, 1863, p. 362, pl. 13, fig. 7.
Planorbis compressus, Hanley & Theobald, Conch. Indica, 1876, pp. lviii and 40, pl. 99, fig. 4.
Planorbis compressus, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Planorbis*, pl. 14, fig. 118*a* and *b*.
Planorbis (*Nautilina*) *saigonensis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 244.
Planorbis (*Nautilina*) *compressus*, Nevill, Ibid., p. 244.
Planorbis confusus, De Rochebrune, Bulletin Societe Philomatique Paris, 1881, p. 32.
Planorbis compressus, Clessin, in Martini-Chemnitz, Conchyl. Cabin., 2nd Ed., XVII, 1886, p. 107, pl. 17, fig. 10.
Planorbis compressus, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 43.
Planorbis saigonensis, Fischer et Dautzenberg, Cat. Moll. Indo-Chine, 1904, p. 414.
Planorbis confusus, Fischer et Dautzenberg, Ibid., p. 414.
Planorbis confusus and *saigonensis*, Bavay et Dautzenberg, Journ. de Conchyl., LVIII, 1910, p. 18.
Planorbis (*Gyraulus*) *compressus*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda, (Freshwater), 1915, p. 118.
Planorbis compressus, Annandale, Rec. Ind. Mus., XV, 1918, p. 166.
Planorbis saigonensis, Annandale, Mem. Asiatic Soc. Bengal, VI, 1918, p. 304.
Planorbis compressus, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1919, pp. 52–54.
Planorbis (*Gyraulus*) *saigonensis*, Germain, Rec. Ind. Mus., XXI, 1921–24, p. 119.

This species has been better known to earlier authors by its synonymous name, *P.* (*Gyraulus compressus*, but since L. Germain's revision of the Planorbidae (*loc. cit.*) the specific name *saigonensis* has come to be accepted in current nomenclature. The shell is much smaller, thinner, paler and much more strongly compressed than in *Planorbis* (*Indoplanorbis*) *exustus*. The shell is markedly depressed and discoidal, rather broad in proportion to the height than in the preceding species. The spire is depressed and sunk below the level of the body whorl. The shell is rather narrowed above, but broad below and the body whorl more or less distinctly keeled along its periphery, this spiral keel being situated slightly below the middle along the entire outer rim of the body whorl. The shell is dextral. The aperture is obliquely pyramidal and angular above, with its lower lip rather produced. The umbilicus is widely open exposing the lower surface of the whorls of the spire. The shell is thin, pale horny yellow or brownish white, with its surface smooth and devoid of sculpture. Ramanan (*loc. cit.*) regards this " as a flattened and rugose variety, or rather, form, of *P. exustus* Deshayes," but this view is no longer accepted, and most authors regard it as a distinct species strictly referable to the sub-genus *Gyraulus* as its characters are sufficiently diagnostic Ramanan (*loc. cit.*), however, has given a good account of the animal and the habits of this species.

Recorded localities : Moradabad, Serampore, Calcutta, Chandernagore, Port Canning, Lake Sambhar, Manbhum, Madras and Vellore, Assam, Delhi, Jamalpur, Bombay, Kutch, Pooree, Ceylon and Yunnan in Burma.

Specimens in the collection : Several spirit-preserved specimens with their soft parts intact, from Bangalore (altitude 3,000 feet). Average measurements : Diameter : major : 8 mm. ; minor : 6 mm. ; height : 2.5 mm. These are slightly smaller than the type measurements cited by Preston (*loc. cit.*).

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ORDER STYLOMMATOPHORA

SERIES SOLEOLIFERA

Family VAGINULIDAE

The animal is elongated and slug-like. The dorsal side is almost always arched and rounded. The body is covered with a coriaceous mantle. The lower tentacles are bifid. The genital orifices are widely separated. The anus and pulmonary orifice are nearly terminal. A shell is absent. This family includes the familiar land slugs.

Genus **Vaginula** Férussac, 1821

(=**Vaginulus**)

(Syn. **Veronicella** Blainville, 1817)

The body is more or less elongated, oblong in the contracted state, but narrow and linear when expanded, acuminated, or sometimes rounded, posteriorly, with the mantle covering the whole of the upper part of the body and separated from the sides by a lateral margin. The foot consists of numerous, narrow, close-set, well marked rings, and is separated from the sides by a deep furrow. The head is distinct, with a prominent buccal mass. There are four unequal, contractile tentacles, the upper pair being long, cylindrical and blunt, bearing the eyes at their tips and the lower pair short and slightly lateral. The generative organs and their orifices are distinct and separate.

Two species, *Vaginula alte* and *V. frauenfeldi*, are represented in the Museum collection. Of these, the former is much the commoner, and is the species that is usually dissected in our laboratories. These are the only two species so far recorded from Madras and its vicinity. All the other species of *Vaginula* are from Ceylon and Burma.

Vaginula alte Férussac

Plate VIII, figs. 1*a* and 1*b*

Vaginulus alte, Férussac, Tabl. Syst. Fam. Limaces, 1821, p. 14.
Vaginulus alte, Férussac, Hist. Nat., Moll., II, pt. 1, 1823, p. 96, pl. 8*A*, fig. 8 ; pl. 8*B*, fig. 6.
Vaginula alte, Fischer, Nouv. Arch. Mus. Hist. Nat., VII, 1871, p. 157.
Veronicella alte, Cockerell, " Check List of Slugs ", The Conchologist, II, 1893, p. 193.
Vaginulus alte, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 65.
Vaginulus alte, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 482.

The animal of this species attains a much larger size than that of the succeeding one. The body is elongated, slightly narrowed anteriorly, and more or less broadly rounded posteriorly. The dorsal surface is convexly arched, but less strongly so than in *V. frauenfeldi*. The integument is almost smooth, but may be seen to be closely studded with minute papillae under the lens. The buccal mass is prominent and globular. The four tentacles show a closely ringed structure. The sole of the foot is comparatively broad and consists of numerous, close-set, narrow, well marked, parallel rings. The foot is separated from the sides by a deep furrow. Anteriorly the foot is somewhat truncated, while posteriorly it is narrowly rounded. The dorsal surface

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of the animal is dark-coloured, almost blackish brown (fading in spirit into a pale yellowish or creamy brown), but the ventral surface is much paler, being of a light yellowish brown tint. Adult specimens collected in and around Madras bear a pale median longitudinal dorsal band, marked with fine black dots, but this band is not so clearly seen in young specimens.

These slugs inhabit moist places, being generally found among dead leaves and other decomposing vegetable matter, and hide themselves under roots of trees or under stones, and sometimes even climb trees and shrubs. They thrive and breed during the monsoon, laying large, oval eggs in gelatinous coils. The animals are copiously slimy in the living condition and crawl quickly, leaving behind them a slimy track. Though they are omnivorous, they live mainly on the roots and leaves of young plants.

Recorded localities : Madras and Pondicherry ; Indian Region as a whole (Cockerell).

Specimens in the collection : Two spirit-preserved specimens, faded into a very pale, uniform whitish brown, in the Gallery collection. Measurements (of the larger specimen) : Length : 57 mm. ; maximum breadth (near the middle) : 19 mm. ; maximum height (near the middle) : 13 mm. ; foot : length : 50 mm. ; width : 9 mm.

Vaginula frauenfeldi Semper

Plate VIII, figs. 2*a* and 2*b*

Vaginula frauenfeldi, Semper, Reisen Arch. Philipp. 2nd Teil, iii, 1885, p. 324, pl. 27, fig. 32.
Veronicella frauenfeldi, Cockerell, " Check List of Slugs ", The Conchologist, II, 1893, pp. 193 and 215.
Vaginulus nov. sp. (?) Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 65.
Vaginulus frauenfeldi, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 483.

The body is elongately ovate, with a strongly convexly arched dorsum, and more or less truncately rounded anteriorly and posteriorly. The integument is thick and leathery, rather smooth, with numerous small and closely set tubercles, these being provided with a pit at the apex which attains a considerable size especially in large specimens. The buccal mass is distinct and rounded. The dorsal surface is greyish brown, with black spots and blotches, and with a median yellow line, which at either end terminates a little distance before reaching the mantle edge. The ventral surface is pale yellowish brown, and the upper tentacles bluish black. The sole of the foot is rather narrow, and the close-set, parallel, transverse folds on the sole number about 40 to every 10 mm. of the length of the sole. The position of the female genital orifice varies with reference to the posterior extremity in different individuals. The species of *Vaginula* doubtfully recorded as a new species from Madras by Ramanan (*loc. cit.*) seems probably referable to the present species, as only two species of *Vaginula*, namely *V. frauenfeldi* and *V. alte* have so far been recorded from Madras.

Recorded localities : India : Madras.

Specimens in the collection : Three adult and two young spirit-preserved specimens from Madras. These specimens are greyish brown with black spots and blotches on the dorsal surface and uniformly dull yellowish brown on the ventral surface. Measurements of the largest specimen : Length : 31 mm. ; breadth : 16 mm. ; sole : length : 21 mm. ; width : 6 mm.

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SERIES SUCCINACEA

Family SUCCINEIDAE

The shell is thin, with a short spire, and sometimes simply inflated, without spire. It is imperforate, usually ovoid, rarely cap-shaped, relatively thin and translucent. The surface of the shell is never smooth, but rarely bears prominent sculpture. The spire is much shorter than the body whorl, never sharply conical, with the whorls rapidly enlarging. The aperture is oval or oblong, with a thin columellar fold, not reflected beyond the columellar margin of the aperture.

Genus **Succinea** Draparnaud, 1801

This genus includes a large number of species of amphibious habitat, with shell of very variable size, shape and texture. The shell is imperforate, oval, thin, horny, more or less translucent. The spire is conical, short, with the whorls rapidly enlarging. The aperture is large and oblong. The columellar fold is thin and has a distinct smooth ridge on its free margin. The peristome is simple and acute. The animal bears a large foot and short tentacles.

Succinea gravelyi Rao

Plate VIII, figs. 3*a* and 3*b*

Succinea gravelyi, Rao, H.S., " Asiatic Succineidae ", Rec. Ind. Mus., XXVI, 1924, p. 401.

It is interesting to note that this species from Madras had been comparatively recently discovered by Dr. H. S. Rao, and had been described as a new species in his paper cited above. His description of the shell of this species is so complete and at the same time precise, that it has been felt desirable to quote it below :—

" The shell is narrowly ovate, relatively thin, translucent, and more or less regularly and finely transpirally striated. It is of a reddish-amber colour except on the apex of the spire and the columellar fold which are often pale in contrast. The spire is short, conical and less than one-third of the total height of the shell, and has a blunt apex. It has, as a rule, $2\frac{1}{4}$ moderately convex whorls, the penultimate oblique and less convex than the last whorl. The suture is not deeply impressed. The aperture is ovate, pointed above and evenly rounded below, and rarely oblique from below the columellar fold. The outer margin of the aperture is very slightly inflexed above. There is often a pearly lustre on the inner surface of the shell. The columellar fold is very thin and minute while its ridge is nearly obsolete."

Dr. F. H. Gravely is reported to have obtained several living specimens of this species on the brick walls of an old well (just above the water level) at the back of a casurina plantation on Elliot's Beach, Adyar, Madras.

Recorded localities : Adyar, Madras.

Specimens in the collection : Four dry-preserved shells from Adyar, Madras. The shells are thin, translucent and pale amber-brown in colour. The obliquely transpiral striations on the

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surface are distinct. Measurements of the largest shell : Height of shell : 8.5 mm. ; height of aperture : 6 mm. ; maximum diameter of shell : 5.5 mm. ; maximum diameter of aperture : 4 mm. The other shells are only slightly smaller. These measurements are considerably larger than those of the two type specimens cited by Dr. H. S. Rao (*loc. cit.*).

SERIES VERTIGINACEA

Family ENIDAE

The shell is usually moderately small, dextral, rarely sinistral, varying from an ovate to a fusiformly cylindrical or tower-shape. The aperture is elongate, with a simple or thickened peristome, which is straight, expanded or reflected, and is either with or without a denticle near the upper margin. The columellar margin is straight and is as a rule without folds.

Sub-family ENINAE

The aperture of the shell is as a rule toothless, sometimes with a ridge-like thickening on the columellar or on the outer margin, very rarely toothed.

Genus **Ena** (Leach) Turton, 1831

The shell is perforate, ranging from a shortly ovate form to an ovately conical or even fusiformly cylindrical shape. The aperture is elongate, its height being about one-third or one-fourth of the total length of the shell. The peristome is simple or thickened and usually only slightly expanded, and with or without a denticle near the upper margin. The shell is usually horny brown, sometimes whitish, and sometimes coarsely striated, often also with spiral lines.

Sub-genus **Mirus** Albers, 1850

The shell is dextral, brownish, elongately ovate-conical, with the aperture ovate and the peristome expanded and thickened.

Ena (**Mirus**) **stalix** (Benson)

Plate VIII, figs. 4*a* and 4*b*

Bulimus stalix, Benson, Ann. & Mag. Nat. Hist., ser. 3, XI, 1863, p. 322.
Bulimus stalix, Pfeiffer, Mon. Helic. Viv., VI, 1868, p. 61.
Bulimus stalix, Hanley & Theobald, Conch. Indica, 1876, p. 11, pl. 22, fig. 3.
Peronaeus stalix, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Buliminus (*Petraeus*) *stalix*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 135.
Bulimina (*Ena*) *stalix*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 289.
Ena stalix, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 297.
Buliminus (*Ena*) *stalix*, Kobelt, Conch. Cab., Fam. Buliminidae, 1900, p. 673, pl. 102, fig. 15.
Buliminus (*Subzebrinus*) *stalix*, Kobelt & Möllendorff, Nachr. Duets. Malak. Ges., 1903, p. 49.
Ena stalix, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 233.

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The shell is more or less elongated and fusiformly conical, solid, and narrowly, but deeply, umbilicated. The surface of the shell is obliquely and irregularly striated. The spire is elongately conical, with an obtusely pointed apex. The sutures are well impressed and appear somewhat sunk. The whorls are seven in number, moderately convex, the body whorl being rather narrowed below. The aperture is slightly oblique, pyriformly ovate with the peristome somewhat expanded, but not appreciably reflected out. The columellar lip of the aperture is broadly expanded and reflected, covering the narrow umbilicus to a considerable extent. The shell is more or less uniformly dark brown. The columellar lip and the inside of the outer lip of the aperture are whitish, while the interior of the aperture is dull brownish. The obliquely transpiral striae on the surface are specially conspicuous towards the basal portion of the body whorl.

Recorded localities : Ceylon : Upper Ourah ; Nuwara Eliya ; Borlande ; Uva, 6,000 feet.

Specimens in the collection : One dry-preserved shell from Nuwara Eliya, Ceylon. The shell is brownish, rather faded towards the apex. The striations on the surface are not very distinct. Measurements : Height : 20 mm. ; maximum diameter : 8 mm. ; aperture : height : 6 mm. ; maximum diameter : 4 mm. These measurements are almost identical with those of the type specimen cited by Gude (*loc. cit.*).

Sub-family NAPAEINAE

The aperture of the shell is without a denticle, and sometimes bears a columellar fold.

Genus **Rachis** Albers, 1850

(Syn. **Rachisellus** Bourguignat, 1889)

The shell is more or less elongately ovate or oblong, and narrowly umbilicated. The surface of the shell is smooth, whitish and usually with brownish striations and a dark band below the middle of the body whorl, which is moderately large and rounded. The aperture is ovate with its columellar margin expanded and strongly reflected, covering the umbilical perforation to a considerable extent. The upper, outer and basal margins of the peristome are straight and acute, not thickened or reflected.

Rachis bengalensis (Lamarck)

Plate VIII, figs. 5*a* and 5*b*

Bulimus bengalensis, Lamarck, Anim. sans vert., VI, pt. 2, 1822, p. 124.
Bulimus bengalensis, Deshayes, Ibid., Ed. 2, VIII, 1838, p. 233.
Bulimus bengalensis, Reeve, Conch. Icon., V, 1848, *Bulimus*, pl. 45, fig. 289.
Bulimus bengalensis, Hanley & Theobald, Conch. Indica, 1876, p. 34, pl. 80, fig. 7 ; pl. 148, fig. 6.
Rachis bengalensis, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Bulimus (*Mesembrinus*) *bengalensis*, Pfeiffer, Malak. Blatt., II, 1856, p. 158.
Bulimus (*Rachis*) *bengalensis*, von Martens, Die Heliceen, Ed. 2, 1860, p. 231.
Buliminus (*Rachis*) *bengalensis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 130.
Bulimina (*Rachis*) *bengalensis*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 285.
Buliminus (*Rachis*) *bengalensis*, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 296.
Buliminus (*Rachis*) *bengalensis*, Peile, Journ. Bomb. Nat. Hist. Soc., XI, 1908, p. 131.
Rachis bengalensis, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., 1903, p. 37.
Rachisellus bengalensis, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 274.

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The shell is ovately conical, acuminated above, rather thin, translucent and smooth. The body whorl is moderately inflated and rounded, the whorls of the spire somewhat convex and the sutures are well impressed. The spire is conical, with an acute apex, which is blackish brown. The whorls are six in number, the body whorl being about equal in height to the remaining part of the shell. The aperture is broadly ovate and the peristome simple, thin and straight, but the columellar margin is dilated and reflected, partly occluding the very narrow umbilicus. The body whorl is considerably narrowed towards the base. The shell is pale yellowish white and the body whorl is encircled by two or sometimes three fairly broad, chestnut-brownish spiral bands. In the whorls of the spire, there are usually two such spiral bands, the lower one of which borders the suture. Reeve's figure of this species, however, shows only two spiral bands on the body whorl and one in each whorl of the spire, closely bordering the suture. Sometimes the lower band is represented only by a thin line. This species may be readily distinguished from the succeeding one, to which it is closely allied, by the shell being broader at the base, the spire being more strictly conical, the colour of the shell being paler and by the surface of the shell being minutely and densely transpirally striated.

Recorded localities : Bengal, Chittagong, Raniganj, Chandernagore, Calcutta, Barrackpore, Bombay and Anamullays in South India.

Specimens in the collection : Two dry-preserved shells from Barkuda Island, collected by Dr. Gravely. They are somewhat worn out and bleached almost white, but the brownish spiral bands, three on the body whorl and two on the whorls of the spire, are distinct. The shell is so thin and translucent that the spiral coloured bands show through on the inner surface. The umbilicus is very narrow and largely covered by the reflected columellar margin. Measurements (of the larger shell) : Height : 15 mm. ; maximum diameter : 7.5 mm. ; aperture : height : 6 mm. ; maximum diameter : 4 mm.

Rachis praetermissus (Blanford)

Plate VIII, fig. 6

Bulimus praetermissus, Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, p. 360.
Bulimus praetermissus, Pfeiffer, Mon. Helic. Viv., VI, 1868, p. 131.
Bulimus praetermissus, Hanley & Theobald, Conch. Indica, 1876, p. 10, pl. 19, fig. 4.
Rachis praetermissus, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Bulimus (Rhachis) praetermissus, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 130.
Bulimina (Rachis) pratermissus, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 285.
Buliminus (Rhachis) praetermissus, Kobelt, Conch. Cab., Fam. Buliminidae, 1900, p. 670, pl. 102, fig. 12.
Rhachis praetermissus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., 1903, p. 38.
Rachisellus praetermissus, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 275.
Rachisellus praetermissus, Godwin-Austen, Rec. Ind. Mus., XIII, 1917, p. 351.

The shell is ovately conical, thin, perforate, smooth, but very finely striated. The spire is conical, with an acute, blackish apex. There are seven whorls, the body whorl being somewhat strongly inflated and rounded towards the base. The aperture is broad, oblique, subovate and the peristome simple, with the columellar margin vertical and reflected outwards. The shell varies considerably in its colour (Gude, *loc. cit.*, describing no less than seven colour varieties

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of this species), but is typically pale yellowish white, variously banded with brownish spiral stripes. Occasionally the apex is white. There are never more than three bands on the body whorl.

This species is closely allied to the preceding one, but the shell in this species has a narrower base and a more slender spire than in the preceding one. The spiral banding is very variable, and occasionally specimens are met with, in which the bands are wanting altogether. This species is said to be intermediate between *R. punctatus* and *R. bengalensis*, and appears to be rather more variable as regards the spiral banding than any other Indian species of *Rachis*.

Recorded localities : Orissa ; Barkuda Island, Chilka Lake, Orissa ; Bengal, Bombay, Salem District and Madurai Hills.

Specimens in the collection : One dry-preserved shell, rather broken around the edge of the aperture, from Nellore District. The shell is very thin, translucent, smooth and glossy ; it is pale yellowish white, with the coloured spiral bands rather faded ; however, three brownish spiral bands may be made out on the body whorl, and two faint brown spiral stripes on the whorls of the spire. The apex is blackish. The specimen seems referable to the sixth colour variety described by Gude (*loc. cit.*) characterized by three stripes of dark brown on the body whorl and two on the upper whorls, and with the apex black. Measurements : Height : 18.5 mm. ; maximum diameter : 11 mm. ; aperture : height : 8.5 mm. ; maximum diameter : 6 mm. These measurements very nearly approach the type measurements quoted by Gude (*loc. cit.*). As the columellar margin of the aperture is rather badly broken in the present specimen, the exact width of the aperture could not be determined accurately.

Rachis pulcher (Gray)

Plate VIII, figs. 7*a* and 7*b*

Bulimus pulcher, Gray, Ann. Philos., new series, IX, 1825, p. 414.
Bulimus pulcher, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 210.
Helix pulchra, Wood, Index Test., Suppl., 1828, pl. 7, fig. 19.
Bulimus mavortius, Reeve, Conch. Icon., V, 1849, *Bulimus*, pl. 77, fig. 561.
Bulimus mavortius, Pfeiffer, Conch. Cab., *Bulimus*, 1853, p. 74, pl. 20, figs. 13 and 14.
Bulimus mavortius, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 423.
Rachis mavortius, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Bulimus mavortius, Hanley & Theobald, Conch. Indica, 1876, p. 59, pl. 148, fig. 5.
Buliminus (*Rhachis*) *mavortius*, von Martens, Die Heliceen, Ed. 2, 1860, p. 231.
Buliminus (*Rhachis*) *pulcher*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 130.
Bulimina (*Rachis*) *pulchra*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 285.
Rhachis pulchra, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., 1903, p. 38.
Rachisellus pulcher, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 276.

The shell is ovately conical, but rather narrower in proportion to the height than in the two preceding species. It is almost imperforate, the umbilicus being nearly completely covered by the thin reflected columellar lip. The whorls are seven in number, the body whorl being somewhat elongately ovate and the spire conical with slightly convex whorls. The surface of the shell is finely and closely transpirally striated, the striae being distinctly seen under the lens.

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The aperture is oblong and rather more narrowly ovate than in the two preceding species. The shell is pale straw-coloured and typically encircled with two bright, pinkish brown spiral bands on the body whorl, and with a narrow purplish spiral band bordering the suture on the other whorls. It is purplish black towards the apex and characteristically speckled here and there with irregular black spots. The columellar lip is rather glossy and deep pinkish in fresh shells. Gude (*loc. cit.*) who had examined the type specimen of *Bulimus mavortius* of Reeve, in the British Museum, states that it has a more slender spire than the typical *Bulimus pulcher* of Gray and hence suggests that this form may perhaps be regarded as a variety of *B. mavortius* rather than as a synonym. The colour and colour markings of this species are subject to considerable variation.

Recorded localities : Ceylon ; Balapiti, Ceylon ; Tiruchirapalli, Travancore and Tinnevelly.

Specimens in the collection : A single dry-preserved shell, rather faded, from Morutuwa, Ceylon. The black freckles are clearly seen, and the pinkish spiral bands can be faintly made out, but the apex is greyish brown, probably having lost much of its original purplish black colour. Oblique transpiral striations are visible under the lens. Measurements : Height : 25 mm. ; maximum diameter : 11·5 mm. ; aperture : height : 11 nm. ; maximum diameter : 7 mm. These are considerably larger than the type measurements cited by Gude (*loc. cit.*).

Rachis punctatus (Anton)

Plate VIII, figs. 8*a* and 8*b*

Bulimus punctatus, Anton, Verz. Conch., 1839, p. 42.
Bulimus punctatus, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 212.
Bulimus punctatus, Reeve, Conch. Icon., V, 1849, *Bulimus*, pl. 65, fig. 452.
Bulimus punctatus, Hanley & Theobald, Conch. Indica, 1876, p. 10, pl. 20, fig. 10.
Rachis punctatus, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Buliminus (*Rhachis*) *punctatus*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 130.
Bulimus (*Rhachis*) *punctatus*, Tryon, Struct. Syst. Conch., III, 1884, p. 49, pl. 99, fig. 62.
Rachis punctatus, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 297.
Rachis punctata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 60.
Rhachis punctatus, Smith, Fauna & Geography of the Maldive & Laccadive Archipelagoes, I, pt. 2, 1902, p. 143.
Rhachis punctata, Kobelt & M llendorff, Nachr. Deuts. Malak. Ges., 1903, p. 38.
Buliminus (*Rachis*) *punctatus*, Peile, Journ. Bomb. Nat. Hist. Soc., XI, 1908, p. 131.
Rachisellus punctatus, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 277.

The shell of this species is readily distinguished from those of all the three preceding species by the presence of a characteristic single thread-like dark brownish spiral band slightly below the middle (infra-peripheral) of the body whorl, and this is also a very constant feature in this species. The shell is ovately conical with a moderately elongated spire, forming a rather straight-sided, regular cone. The whorls are six in number, with rather flattened walls, not appreciably convex. The surface of the shell is smooth and somewhat glossy. The aperture is rather narrowly and elongately ovate, with the outer lip thin and its edge sharp, and the columellar lip broadly reflected, occluding the deep umbilicus to a considerable extent. The shell is pale brownish white, marked with numerous irregularly scattered black spots and ornamented with a very distinct and sharply defined dark reddish brown spiral band just a little below the middle of the body whorl. The apex is blackish. Occasionally the spiral band is interrupted by transverse streaks

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and in some shells there is a second band below the principal one, but these are only casual variations. Ramanan (*loc. cit.*) makes mention of a specimen of this species in the Madras Museum which he thinks to be an abnormal, and possibly exotic variety, but this specimen is unfortunately not now traceable in the Museum collection. It is said to have been much thicker than the normal shell, and without the dark reddish brown spiral band of the normal shell, but, on the other hand, marked with two brown striations which extend to the whorls of the spire also, instead of being confined to the body whorl. There is considerable variation in the size of the shells of this species collected from various localities.

Recorded localities : This species has a wide distribution, its range extending as far as Africa in the west. Some of the localities from which it has been definitely recorded are : Bundelkhund, Oolooberiah, near Calcutta, and Banaras ; Poona, Ahmednuggar, Bombay Island ; Southern India : Madras, Tiruchirapalli, Nullamullays, Travancore, Orissa : Ceylon, Laccadive Archipelago and Africa.

Specimens in the collection : Four dry-preserved shells from Madras, and another four, also dry-preserved, from Tripatur, Ramnad District. All the specimens have the characteristic reddish brown spiral band, which, in some of these shells, however, is edged with a thread-like, opaque white spiral band immediately below it. Average measurements : Height : 14 mm. ; maximum diameter : 7 mm. ; aperture : height : 6 mm. ; maximum diameter : 3·5 mm. These measurements are considerably larger than those of the type cited by Gude (*loc. cit.*), but specimens much larger than the present ones have been recorded from other localities such as Ceylon, Zanzibar and Mozambique.

Genus **Cerastus** (Albers) Martens, 1860

The shell is usually medium-sized and coloured brownish, with the umbilicus covered by the columellar margin, sometimes closed. The spire is sometimes moderately low and depressed, but sometimes elevated and conical. The surface is either smooth or striated. The body whorl is usually large, rounded and about as high as the spire. The aperture is ovate, the peristome being reflected and its margins approximated and united by a thin callus.

Cerastus malabaricus (Pfeiffer)

Plate VIII, figs, 9*a* and 9*b*

Bulimus malabaricus, Pfeiffer, Malak. Blatt., IV, 1857, p. 156.
Bulimus malabaricus, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 411.
Cerastus malabaricus, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Buliminus (*Cerastus*) *deccanensis* (Blanford), Nevill, Hand List, Moll. Ind. Mus., I, 1878, p. 133.
Bulimina (*Cerastus*) *malabarica*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 286.
Cerastus malabaricus, Kobelt & Möllendorff, Nachr. Deuts. Malak. Ges., 1903, p. 41.
Cerastus malabaricus, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 264.

The shell is solid, ovately conical and narrowly umbilicated. The spire is elongately conical with an obtuse apex and slightly convex whorls. The shell is composed of six whorls, the body whorl being somewhat elongately ovoid, moderately inflated and about two-fifths of the total

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length of the shell. The aperture is oblique, ovate and acutely angular above. The peristome is thin and reflected out, its columellar margin being expanded and partly covering the umbilicus; the upper edges of the peristome are approximated and connected by a thin callus layer. The surface of the shell is traversed by very fine, obliquely transpiral and close-set striae on the body whorl, where the transverse striae are less distinct than on the other portions of the shell. The shell is more or less of a uniformly dirty white colour.

Recorded localities : India : Ahmednuggar, Deccan.

Specimens in the collection : Two dead shells from Malabar, South India. Since these two specimens are from Malabar, Blanford's proposal to change the name of this species to *C. deccanensis* on the plea that it does not occur in Malabar, but only in the Deccan, is not justified. The locality " Malabar " has not been previously recorded for this species. Measurements (of the larger shell) : Height : 20·5 mm. ; maximum diameter : 10·5 mm. ; aperture : height : 8 mm. ; maximum diameter : 5 mm. These measurements are considerably larger than those of the type specimen cited by Gude (*loc. cit.*). The obliquely transpiral striae are quite distinct under the lens on the surface of all the whorls in both the specimens. The umbilicus is narrow and deep and partly overlapped by the reflected columellar lip.

Cerastus jerdoni (Reeve)

Plate VIII, figs. 10*a* and 10*b*

Bulimus jerdoni (Benson), *Reeve*, Conch. Icon., V, 1848, *Bulimus*, pl. 46, fig. 297.
Bulimus jerdoni, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 335.
Bulimus jerdoni, Pfeiffer, Conch. Cab., *Bulimus*, 1853, p. 73, pl. 20, figs. 11 and 12.
Bulimus (Petraeus) jerdoni, Pfeiffer, Malak. Blatt., II, 1856, p. 154.
Bulimus jerdoni, Hanley & Theobald, Conch. Indica, 1876, p. 11, pl. 21, fig. 7.
Cerastus jerdoni, Theobald, Cat. Shells Brit. India, 1876, p. 27.
Buliminus (Cerastus) jerdoni, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 132.
Buliminus (Cerastus) jerdoni, Kobelt, Conch. Cab., Fam. Buliminidae, 1902, p. 893, pl. 127, figs. 17 and 18.
Bulimina (Cerastus) jerdoni, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 286.
Cerastus jerdoni, Kobelt & Möllendorff, Deuts. Malak. Ges., 1903, p. 40.
Cerastus jerdoni, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 266.

The shell is rather broadly and ovately conical, the width being much greater in proportion to the height than in the preceding species. The umbilicus is wide and deep, and not appreciably covered by the columellar lip. The spire is rather short and broad at its base, its outline being roughly in the shape of an equilateral triangle and acuminated towards the apex. The whorls are six in number, somewhat convex, inflated and rounded. The aperture is broadly rounded, but angular above. The peristome is expanded, but only very slightly reflected. The columellar lip is thin and reflected out, but only slightly covering the comparatively wide umbilicus. The upper edges of the peristome are connected by a thin callus layer. The surface of the shell is traversed throughout by fine, close-set, obliquely transpiral striae, which appear to be more regular and distinct than in the preceding species. The shell is pale olive or horny brown in colour.

Recorded localities : India : Deccan, Poona, Ahmednuggar.

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Specimens in the collection : Two dry-preserved shells from Malabar, bleached almost uniformly whitish, but the fine transpiral striae on the surface are distinct. Measurements (of the larger shell) : Height : 22 mm. ; maximum diameter : 13 mm. ; aperture : height : 8·5 mm. ; maximum diameter : 6 mm. These measurements are appreciably larger than the type measurements quoted by Gude (*loc. cit.*) where, however, the apertural measurements are not given.

SERIES ACHATINACEA

Family FERUSSACIDAE

The shell is imperforate, very small and slender, narrowly tower-shaped, thin, with an obtuse, smooth and rounded apex. The surface is smooth and the shell is somewhat fragile and translucent (opaque white in worn specimens). The aperture is ovate or pear-shaped, sometimes denticulated. The columella is concave and usually truncated or even indented at the base. The peristome is often thickened on the inside.

Genus **Glessula** Martens, 1860

(Syn. **Electra** Albers, 1850, non Lamouroux, 1816, nec Stephens, 1829)

The shell is imperforate, ovately conical or turretted, brownish or horny brown, usually smooth and glossy and without well marked sculpture. The apex is obtuse and the aperture ovate, with the peristome usually blunt and not expanded. The columella is concave and truncated at the base.

In most species of this genus, the lip becomes slightly blunt and smooth in the fully grown shells, thereby differing from the succeeding genus, *Subulina*, which has an acute lip at all stages of growth. Although about fifty species of this genus have been recorded from various localities in Southern India, it is rather surprising that only five species should be represented in the Museum collection.

Glessula mullorum (Blanford)

Plate IX, figs. 1*a* and 1*b*

Achatina mullorum, Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, p. 362, pl. 1, fig. 17.
Achatina mullorum, Pfeiffer, Mon. Helic. Viv., VI, 1868, p. 228.
Achatina mullorum, Hanley & Theobald, Conch. Indica, 1876, p. 41, pl. 102, fig. 5.
Stenogyra (*Glessula*) *mullorum*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 167.
Glessula mullorum, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 331.
Glessula mullorum, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 63.
Glessula mullorum, Beddome, Proc. Malacol. Soc. London, VII, 1906, p. 171.
Glessula mullorum, Pilsbry, Man. Conch., ser. 2, XX, 1909, p. 84, pl. 13, fig. 10.
Glessula mullorum, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 437.

This is characteristically a Madras species, and has not been recorded from elsewhere so far. Dr. W. T. Blanford, who described this species first, is said to have obtained a large number of specimens from a garden at Nungambakkam in Madras.

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The shell is small, elongately turretted, solid, pale horny brown, glossy and translucent. The surface is very finely and closely transpirally striated. The spire is somewhat elongated and tower-shaped, the apex being obtuse and the sutures well impressed. The whorls are six in number, moderately convex, and the body whorl is about one-third of the total length of the shell, and is rounded towards the base. The columella is short, concavely arched, covered with callus and obliquely truncated below. The aperture is vertical, almost semi-circular, with a blunt, straight peristome which is internally thickened at the margin. The canal-like indentation caused by the abruptly truncated condition of the columellar lip at its base is characteristic.

Ramanan (*loc. cit.*) has given a good account of the soft parts and habits of the animal of this species. It frequents decayed leaves, under trees, near banks of rivers and in gardens. Several living specimens have been collected from gardens at Nungambakkam in Madras. They are gregarious, and occur only during the rainy season.

Recorded localities : Madras ; Nungambakkam, Madras.

Specimens in the collection : Two dry-preserved, empty shells from Madras, and one spirit-preserved specimen with the soft parts intact, also from Madras. The shells are pale horny brown, with a dull gloss on the surface. Measurements (of the largest shell) : Height : 7·5 mm. ; maximum diameter : 4·5 mm. ; aperture : height : 2·5 mm. ; maximum diameter : 1·5 mm.

This species is closely allied to *G. gemma* and *G. scrutillus*, from which the shell is distinguished by its conical spire with straight, instead of convex sides.

Glessula paupercula (Blanford)

Plate IX, figs. 2*a* and 2*b*

Achatina paupercula, Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, p. 362, pl. 1, fig. 16.
Achatina paupercula, Pfeiffer, Mon. Helic. Viv., VI, 1868, p. 227.
Glessula paupercula, Theobald, Cat. Shells, Brit. India, 1876, p. 29.
Achatina paupercula, Hanley & Theobald, Conch. Indica, 1876, p. 41, pl. 102, fig. 1.
Stenogyra (*Glessula*) *paupercula*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 169.
Glessula paupercula, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 331.
Glessula paupercula, Beddome, Proc. Malacol. Soc. London, VII, 1906, p. 170.
Glessula paupercula, Pilsbry, Man. Conch., ser. 2, XX, 1909, p. 81, pl. 13, fig. 9.
Glessula inconspicua, (Nevill), Beddome, *loc. cit.*, p. 170.
Glessula paupercula, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 431.

The shell is more or less elongately spindle-shaped and turretted, solid, and somewhat glossy on the outside. The surface of the shell is finely and closely transpirally striated. The spire is elongated and tower-shaped, with an obtuse apex, and with the sutures distinctly marginated below. The whorls are seven in number and moderately convex. The body whorl is somewhat elongately ovoid and about one-third of the total length of the shell. The columella is broadly arched, and abruptly truncated basally. The aperture is rather narrow, ovately pyriform with a straight peristome which is internally thickened. The shell is deep fulvous horny in colour.

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Recorded localities : Kolamullays, Patchmullays, Shevroy Hills, Shevroy, Salem, Anamalais, Tinnevelly, Travancore Hills and Kurnool Hills.

Specimens in the collection : Two dry shells from the Shevroy Hills, one of which is horny brown and glossy, while the other is bleached into a dull opaque white. They were originally labelled *G. suturalis*, but this was obviously an error. Measurements (of the larger shell) : Height : 9.5 mm. ; maximum diameter : 3.75 mm. ; aperture : height : 3.5 mm. ; maximum diameter : 2 mm. These measurements are slightly larger than the type measurements cited by Gude (*loc. cit.*).

Glessula tornensis Blanford

Plate IX, figs. 3*a* and 3*b*

Glessula tornensis, Blanford, Journ. Asiatic Soc. Bengal, XXXIX, 1870, p. 22, pl. 3, fig. 22.
Glessula tornensis, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 330.
Achatina (*Electra*) *tornensis*, Hanley & Theobald, Conch. Indica, 1876, p. 33, pl. 78, fig. 3.
Glessula tornensis, Theobald, Cat. Shells Brit. India, 1876, p. 30.
Achatina tornensis, Pfeiffer, Mon. Helic. Viv., VIII, 1877, p. 278.
Stenogyra (*Glessula*) *tornensis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 167.
Glessula tornensis, Beddome, Proc. Malacol. Soc. London, VII, 1906, p. 163.
Glessula tornensis, Pilsbry, Man. Conch., ser. 2, XX, 1909, p. 69, pl. 11, figs. 3 and 4.
Glessula tornensis, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 389.

The shell is much larger and much broader in proportion to the height than in the two preceding species. It is broadly and ovately conical, rather thin, smooth, glossy and traversed on the surface by very fine, almost obsolete, transpiral striae. The spire is elongately conical, but much wider at its base than in the preceding species which have comparatively slender shells. The whorls of the spire are moderately convex, the sutures strongly impressed and the apex broadly obtuse. The body whorl is moderately inflated and elongately ovoid and is about three-fifths of the total length of the shell. The aperture is almost vertical, and elongately pear-shaped or semi-ovate in outline. The columellar margin is concavely arched and sharply truncated basally, while the peristome is straight, thin and marginally slightly thickened within. The shell is pale horny brown in colour. The strongly impressed sutures, the broad, bluntly obtuse spire and the stoutly ovate-conical shape of the shell are characteristic features of this species, serving to distinguish it from the others of this genus recorded in the present account.

Recorded localities : Torna Hills, near Poona, in Western India ; Anamalais, Tinnevelly and Travancore Ghats.

Specimens in the collection : One dry-preserved shell from the Western Ghats. It is very pale horny brown, smooth, with very feeble indications of transpiral striae, and glossy on the surface. Measurements : Height : 25 mm. ; maximum diameter : 14 mm. ; aperture : height (oblique) : 12 mm. ; maximum diameter : 7 mm. These measurements are identical with those of the type specimen cited by Gude (*loc. cit.*).

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Glessula tenuispira (Benson)

Plate IX, figs. 4*a* and 4*b*

Achatina tenuispira, Benson, Journ. Asiatic Soc. Bengal, V, 1836, p. 356.
Achatina tenuispira, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 262.
Achatina tenuispira, Reeve, Conch. Icon., V, 1849, *Achatina*, pl. 16, fig. 76.
Achatina tenuispira, Benson, Ann. & Mag. Nat. Hist., ser. 3, V, 1860, p. 464.
Achatina tenuispira, Blanford, Journ. Asiatic Soc. Bengal, XXXIV, 1865, p. 95.
Subulina tenuispira, Adams, Genera of Recent Mollusca, II, 1855, p. 110.
Achatina (Subulina) tenuispira, Pfeiffer, Malak. Blatt., II, 1856, p. 169.
Achatina (Electra) tenuispira, Hanley & Theobald, Conch. Indica, 1876, p. 17, pl. 36, fig. 8.
Glessula tenuispira, Theobald, Cat. Shells Brit. India, 1876, p. 30.
Steonogyra (Glessula) tenuispira, Nevill. Hand List Moll. Ind. Mus., I, 1878, p. 469.
Stenogyra (Subulina) tenuispira, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 327.
Glessula tenuispira, Beddome, Proc. Malacol. Soc. London, VII, 1906, p. 160.
Glessula tenuispira, Pilsbry, Man. Conch., ser. 2, XX, 1909, p. 88, pl. 9, figs. 1 and 4.
Glessula tenuispira, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 378.

The shell is readily distinguished from those of the preceding species by its greatly elongated and rather attenuated form (as indicated by the specific name) and by the far greater number of whorls. The shell is narrow and elongately turretted, thin, translucent and slightly glossy on the surface. The whorls are about twelve in number, with slightly convex walls and deeply impressed sutures, and very gradually enlarging from apex downwards. The surface of the shell is sculptured with fine, raised, obliquely transpiral ridge-like striae. The columellar margin is deeply arched and sharply truncated basally. The peristome is thin, straight and sharp-edged, and the aperture rather narrowly ovate. The shell is horny brown in colour and of a delicate translucent texture. The greatly attenuated spire tapers gradually towards the apex which is slightly obtuse.

Recorded localities : India : Sylhet, Darjeeling, Khasi and Dafla Hills, Assam ; North Canara ; Burma ; Akoutong and further south ; banks of the River Irrawady.

Specimens in the collection : It seems strange that this species has not so far been recorded from localities farther south than North Canara, as there are two dry-preserved shells, of which one is obviously immature and the other an adult specimen, from Shevroy Hills, in the Museum collection. The young shell is barely more than half the length of the adult one, and has fewer whorls (only about eight) but is comparatively stouter and broader in proportion to its total length than the adult specimen. Measurements (of the adult shell) : Height : 27 mm. ; maximum diameter : 7 mm. ; the aperture is very narrow, and its measurements could not be accurately determined as the lip of the aperture is slightly broken.

Glessula perrotteti (Pfeiffer)

Plate IX, figs. 5*a* and 5*b*

Achatina perroteti, Pfeiffer, Revue Zool., 1842, p. 305.
Achatina perrotteti, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 260.
Achatina (Subulina) perrotteti, Albers, Die Heliceen, 1850, p. 195.
Oleacina (Electra) perrotteti, Adams, Genera of Recent Mollusca, II, 1855, p. 106.
Achatina (Electra) perrotteti, Pfeiffer, Malak. Blätt., II, 1856, p. 168.
Cionella (Glessula) perroteti, von Martens, Die Heliceen, Ed. 2, 1860, p. 254.
Stenogyra (Glessula) perotteti, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 168.
Stenogyra (Glessula) perotteti, Nevill, Journ. Asiatic Soc. Bengal, I, 1881, p. 137, pl. 5, figs. 17 and 17*a*.
Glessula perrotteti, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 330.
Glessula perrotteti, Beddome, Proc. Malacol. Soc. London, VII, 1906, p. 162.
Glessula perrotteti, Pilsbry, Man. Conch., ser. 2, XX, 1909, p. 65, pl. 9, figs. 9 and 10.
Glessula perrotteti, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 386.

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The shell is moderately large, elongately conical, with an elevated spire and an obtuse apex. The surface of the shell is smooth, and the sutures deeply impressed. The whorls are rather convex and about seven in number. The spire is more or less elongately conical, and the body whorl elongately ovoid and about half the total length of the shell. The columella is deeply arched and abruptly truncated below. The aperture is more or less narrowly ovate, and the peristome thin and straight. The shell is somewhat thin, glossy on the surface, and pale horny brown in colour. Fine, close-set, transpiral striae can be made out under the lens, throughout the surface of the shell.

Recorded localities : Nilgiris ; Neddoowutton, Nilgiris ; Pulney Hills.

Specimens in the collection : One spirit-preserved specimen with the soft parts intact, from Law's Ghat Road, (altitude : 4,500 feet), Pulney Hills. The soft parts are jet black in this specimen. The shell is pale horny or straw-brown, slightly greyish towards the apex. Measurements : Height : 26 mm. ; maximum diameter : 12 mm. ; aperture : height (oblique) : 10·5 mm. ; maximum diameter : 5 mm.

Family SUBULINIDAE

The shell is variable in form, ranging from a turretted to a cylindrical shape, more rarely elongately ovate, and, as a rule, uniformly coloured and without internal lamellae. The columella is either truncated or expanded at its lower margin.

Sub-family SUBULININAE [1]

The columella is, as a rule, truncated below.

Genus **Subulina** Beck, 1837

The shell is imperforate, more or less elongately turretted, thin-walled and usually more or less translucent ; the apex is obtuse and rounded. The aperture is small, oblique and ovate. The columella is concavely arched above and truncated below. The body whorl is either angular or rounded at the periphery.

Formerly several species from the Indian Region were supposed to belong to this genus, but subsequently most of these species were removed from the genus owing to their uncertain generic relationships, and only the commonest and best known species, *viz.*, *Subulina octona*, has been retained in the genus *Subulina*, and this has since been selected as the type of the genus *Subulina*, s. str., although there are other sub-genera under *Subulina* to which other species have been referred.

[1] Gude includes the genus *Subulina* Beck in the sub-family Stenogyrinae under the family Achatinidae, and Ramanan includes *Subulina* under the family Stenogyridae. We have, however, followed Thiele's latest classification in which *Subulina* is brought under the sub-family Subulininae of the family Subulinidae, and Achatinidae is separated as a distinct family altogether.

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Subulina octona (Bruguière)

Plate IX, figs. 6*a* and 6*b*

Bulimus octonus, Bruguière, Encyclopédie Méthodique, Vers. I, 1789, p. 325.
Achatina octona, Reeve, Conch. Icon., V, 1849, *Achatina*, pl. 17, fig. 84.
Achatina octona, Sowerby, Conch. Man., 1852, fig. 514.
Subulina octona, Adams, Genera of Recent Mollusca, II, 1855, p. 110, pl. 71, fig. 3*a*.
Subulina crotallaria, (Schumacher) Mörch, Journ. de Conchyl., 1872, p. 337.
Stenogyra (Subulina) octona, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 326,
Subulina octona, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 63.
Subulina octona, Pilsbry, Man. Conch., ser. 2, XVIII, 1906, p. 72, pl. 12, figs. 8 and 9 ; p. 222, pl. 39, figs. 28-37, 39 and 40.
Stenogyra octona, Peile, Journ. Bombay Nat. Hist. Soc., XII, 1909, p. 785.
Subulina octona, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 341.
Subulina octona, Thiele, Handbuch der systematischen Weichtierkunde, I, 1931, p. 549.

Although this is one of the commonest and most widely distributed species of freshwater molluscs, it is surprising that many of the earlier conchologists working on Indian freshwater molluscs should have overlooked this species, until its occurrence in the Oriental Region was first pointed out by Ramanan (*loc. cit.*) in 1909. It is practically world-wide in distribution, occurring both in the western and eastern hemispheres, but is believed to have been introduced into the Tropics chiefly through the agency of coffee plants.

The shell is thin, translucent, narrow and greatly elongated and tower-shaped, regularly and gradually tapering from below upwards to the apex which is rather obtuse and rounded. The surface of the shell is practically smooth and glossy, but coarse, obliquely transpiral striations can be made out under the lens. The whorls are nine in number, rather strongly convex and separated by deeply impressed sutures. The body whorl is rounded and not markedly larger nor more inflated than the whorl next above it. The sutures separating the uppermost whorls of the spire are crenulated by a margin of fine folds. The aperture is oblique and rather narrowly ovate. The columella is concavely arched above, somewhat twisted, and obliquely truncated at its base. The surface of the shell presents a peculiar waxy, glossy appearance and the deeply impressed sutures render the whorls more or less globose in shape. The shell is pale straw-coloured or horny brown.

The animal of this species is translucent, greyish brown, with yellowish grey tentacles, the upper pair bearing the eyes. The foot bears a narrow pale grey margin, and is truncated in front and obtusely pointed behind.

Living specimens of this species frequent humid and semi-aquatic surroundings such as ferneries, among fresh and decomposing leaves in gardens and amidst flower pots and water cisterns. They are met with almost throughout the year, but are abundant only during the monsoons.

Recorded localities : India : Tranquebar, Bombay, Madras ; Ceylon. But as already pointed out, this species is widely distributed and has an extensive range outside India, both in the western and eastern hemispheres.

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Specimens in the collection : Dry shells : Eight dry-preserved shells, all from Madras City. Of these only two appear to be full grown specimens. The two adult shells have nine whorls each, but in the younger shells the number of whorls is much less, some of them having only six and others seven, and the apex is also comparatively more obtusely truncated. The shells are pale yellowish horny-brown and more or less glossy. Spirit specimens : There are also several full-grown spirit-preserved specimens from Madras, with shells of a very pale yellowish straw-brown colour. Measurements (of the average adult shell) : Height : 18.5 mm. ; maximum diameter : 4.5 mm. ; aperture : height : 3.5 mm. ; maximum diameter : 2.5 mm. These measurements lie within the range of size cited for this species by Gude (*loc. cit.*), but the specimens should be considered as large for this species, as the measurements approach the upper limit very closely.

Sub-family OPEATINAE

The columella is not truncated below, but rounded.

Genus **Opeas** Albers, 1850

The shell is small, usually perforate, thin-walled and turretted, with an obtusely rounded apex. The surface of the shell is smooth and the whorls are more or less inflated. The aperture is moderately small and ovate, and the outer lip thin, and often arched forward. The columella is usually straight or concave, and the columellar lip reflected. This genus includes small, thin-shelled oviparious snails inhabiting moist situations.

Opeas gracile (Hutton)

Plate IX, figs. 7*a* and 7*b*

Bulimus No. 5 ?, Hutton, Journ. Asiatic Soc. Bengal, III, 1834, p. 84.
Bulimus gracilis, Reeve, Conch. Icon., V, 1849, *Bulimus*, pl. 69, fig. 495.
Bulimus gracilis, Blanford, Journ. Asiatic Soc. Bengal, XXXIV, 1865, p. 94.
Bulimus gracilis, Hanley & Theobald, Conch. Indica, 1876, p. 12, pl. 23, fig. 4.
Bulimus gracilis, Godwin-Austen, Journ. Asiatic Soc. Bengal, XLV, 1876, p. 317.
Steonogyra (*Opeas*) *gracilis*, von Martens, Die Heliceen, ed. 2, 1860, p. 265.
Stenogyra panayensis, Semper, Reis d. Philippinen, III, (1870–94), pp. 137 and 138.
Stenogyra (*Opeas*) *gracilis*, Nevill, Journ. Asiatic Soc. Bengal, XLVI, 1877, p. 25.
Stenogyra (*Opeas*) *gracilis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 164.
Spiraxis gracilis, Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, p. 362.
Stenogyra gracilis, Peile, Journ. Bombay Nat. Hist. Soc., XI, 1908, p. 131.
Opeas gracilis, Theobald, Journ. Asiatic Soc. Bengal, XLVII, 1878, p. 146.
Opeas gracilis, Theobald, Cat. Shells, Brit. India, 1876, p. 28.
Opeas gracilis, Godwin-Austen, Proc. Zool. Soc. London, 1895, p. 443.
Opeas gracilis, Smith, Fauna & Geography of the Maldive & Laccadive Archipelagoes, I, pt. 2, 1902, p. 141.
Opeas gracile, Möllendorff, Proc. Zool. Soc. London, 1894, p. 151.
Opeas gracile, Pilsbry, Man. Conch., ser. 2, XVIII, 1906, p. 125, pl. 18, figs. 3–6.
Bulimus indicus, Pfeiffer, Proc. Zool. Soc. London, 1846, p. 40.
Opeas gracile, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 63.
Opeas indicus, Dautzenberg & Fischer, Journ. de Conchyl., LIII, 1905, p. 102.
Opeas gracile, Gude, Fauna Brit. India. Mollusca, II, 1914, p. 355.
Opeas gracilis, Annandale & Prashad, Rec. Ind. Mus., XIX, 1920, p. 193.
Opeas gracile, Annandale & Rao, Rec. Ind. Mus., XXV, 1923, p. 394.
Opeas gracile, Annandale & Chopra, Rec. Ind. Mus., XXVI, 1924, p. 33.

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This is a widely distributed species and is reported to be an extremely common form in Madras City. It is allied to the preceding species which it resembles not only in the general form and size of the shell, but also in the habits and habitat of the living animal.

The shell is rather small, thin, translucent, slender and tower-shaped, with the spire gradually tapering from below upwards, and terminating above in a bluntly rounded, obtuse apex. Hutton, in his original description, cites the number of whorls as twelve, but the number of whorls appears to be a variable factor in this species ; Gude (*loc. cit.*) states that in some of the specimens he had examined there were only nine or ten whorls and Reeve (*loc. cit.*) cites the number of whorls as ten or eleven. The specimens in the Madras Museum collection have not more than nine whorls. The shell is scarcely perforate. The sutures are rather deeply impressed rendering the whorls moderately convex and inflated. The surface of the shell is practically smooth and glossy, but under the lens it is seen to be finely and closely transpirally striated. The aperture is longer than broad, semiovate and rather narrowed above. The columellar lip is more or less straight and slightly reflected. The outer lip is thin and sharp-edged. The shell is of a uniformly dull horny brown colour.

In the living animal, the body is thin, semi-transparent and pale yellowish, with two pairs of greyish orange tentacles, of which the upper pair are longer and bear the eyes. The foot is elongated, truncated in front and rounded behind. The habits of this species are very similar to those of *Subulina octona*. Living specimens inhabit moist localities in large numbers, and have been known to be particularly abundant in flower pots and ferneries. They are found almost throughout the year, though abundant only during the monsoons and a little later. Like *Subulina octona* this species starts laying eggs before the shell has attained its full size. Living specimens of *Opeas gracile* are preyed upon in large numbers by the carnivorous land snail *Ennea bicolor* with which it is frequently found in association (Annandale & Prashad, *loc. cit.*, 1920, p. 193, and Annandale & Chopra, *loc. cit.*, 1924, p. 34).

Recorded localities : As already mentioned, this species has a wide range of distribution both within and outside India, its range eastwards extending as far as China, Formosa, Japan and the Malay Archipelago. As the list of recorded localities of this species is too long even within Indian limits, only the more important among them are mentioned below : Mirzapore, Calcutta, Erode, Poona, Bombay, Assam, Khasi Hills, Dafla Hills, Madras, Naini Tal, Salt Range, Roorkee, Burma, Ceylon, and Andaman, Nicobar and Laccadive Islands. The form recorded from Barkuda Island, Orissa, as *Opeas gracile* seems strictly referable to *O. annandalei*, which is described next.

Specimens in the collection : Four dry-preserved shells, two of them half-grown and two adult ones, all from Madras City, and three smaller spirit-preserved specimens with creamy white shells collected by Dr. Gravely from Madras. The largest of the spirit-preserved shells is only about 11 mm. high. The immature dry-preserved specimens have been collected in the Museum compound. The full-grown shells have nine whorls each, while the young shells have only six whorls, with the apex worn away. The larger shells are roughly of the size indicated by Reeve (*loc. cit.*). Measurements (of the largest adult dry shell) : Height : 14.5 mm. ; maximum

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diameter : 4.5 mm. ; aperture : height : 3 mm. ; maximum diameter : 1.5 mm. British Museum specimens from Mirzapore are cited by Gude (*loc. cit.*) as measuring 13.5 mm. long and 3.5 mm. broad at their widest part.

Opeas annandalei Godwin-Austen

Plate IX, figs. 8*a* and 8*b*

Opeas gracilis (?), Godwin-Austen, Rec. Ind. Mus., XIII, 1917, p. 351.
Opeas gracilis (?), Annandale & Prashad, Rec. Ind. Mus., XIX, 1920, p. 193.

I have unfortunately not been able to get at the original reference to this species, where Col. Godwin-Austen had described it under the specific name *annandalei*, even after referring to the Zoological Survey of India on this point. However, from a study of the references cited above, it seems fairly clear that the form of *Opeas gracilis* inhabiting Barkuda Island, in the Chilka Lake, Ganjam District, Orissa, is distinct from the typical form of *O. gracilis*, and as such, should have been described by Col. Godwin-Austen as a distinct species, for Annandale & Prashad (*loc. cit.*, p. 193), state that they found on Barkuda Island specimens of *E. bicolor* race *barkudensis* " accompanied in much larger numbers by an *Opeas* which Col. Godwin-Austen has identified provisionally as *O. gracilis* ", and add, in a foot note to that page that he proposed to describe this form as a new species. Col. Godwin-Austen himself (*loc. cit.*, p. 351) admits that there are points of difference between this form and other specimens of the typical form from the type locality, Mirzapur. Specimens (of the former form) of *Opeas* are reported to have been found in the earth under a log of wood on Barkuda Island by Col. Godwin-Austen.

However, as there is a fairly good series of shells from Barkuda Island in the Museum collection, authentically identified and labelled as *Opeas annandalei* by Dr. Gravely, it is proposed to describe it under this new specific nomenclature in the present account.

The shell is somewhat smaller than in the preceding species, thin, translucent and more or less slender and tower-shaped. The spire is proportionately shorter than in *Opeas gracile*, the shell being less gradually tapered than in that species. The shell bears only seven whorls, including the body whorl. The body whorl is appreciably larger than the two preceding whorls, while in *O. gracile* the body whorl is almost of the same size as the two preceding whorls. The aperture is somewhat narrowly ovate with the columellar lip slightly more strongly reflected than in the preceding species. The shell is pale horny brown, with a slight gloss, and very finely and closely transpirally striated under the lens. The sutures are well impressed and the apex is more acutely pointed than in the preceding species.

Recorded localities : Barkuda Island, Chilka Lake, Ganjam District, Orissa.

Specimens in the collection : Ten adult and three young empty dry-preserved shells, and four spirit-preserved specimens of which three are very young, barely exceeding 5 mm. in length—all from Barkuda Island, Chilka Lake, Ganjam District, Orissa, collected by Dr. Gravely. They vary in colour from a pale straw-brown to a dirty white. Measurements (of the largest adult dry shell) : Height : 10 mm. ; maximum diameter : 4 mm. ; aperture : height : 3 mm. ; width : 1.5 mm.

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Sub-family RUMININAE

The shell is elongately turretted, with small aperture and reflected columellar margin ; the columella is not truncated below.

Genus **Zootecus** Westerlund, 1887

(Syn. **Chilogymnus** Jousseaume, 1894)

The shell is rather small, very narrowly perforated, usually smooth and glossy throughout, pupiform or cylindrical with a conical and pointed apex. The surface is finely spirally striated and somewhat glossy. The aperture is small and ovate, and the columellar margin straight or concave, and thickened with callus. The outer lip of the aperture is blunt.

Zootecus chion (Pfeiffer)

Plate IX, figs. 9*a* and 9*b*

Bulimus chion, Pfeiffer, Proc. Zool. Soc. London, 1856, p. 332.
Pupa (*Cylindrus*) *chion*, von Martens, Die Heliceen, ed. 2, 1860, p. 297.
Bulimus chion, Hanley & Theobald, Conch. Indica, 1876, p. 11, pl. 22, fig. 1.
Cylindrus chion, Theobald, Cat. Shells Brit. India, 1876, p. 30.
Pupa (*Cylindrus*) *insularis*, var. *chion*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 195.
Bulimina (*Mastus*) *chion*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 293.
Rumina chion, Ancey, Bull. Soc. Malacol. France, III, 1886, p. 60.
Bulimus chion, Adams, Journ. Conchol., VII, 1892, p. 81.
Mastus chion, Ancey, Bull. Soc. Zool. France, XVIII, 1893, p. 44.
Buliminus (*Zootecus*) *chion*, Kobelt, Conch. Cab., Fam. Buliminidae, 1900, p. 675, pl. 102, fig. 18.
Zootecus insularis forma *chion*, Pilsbry, Man. Conch. ser. 2, XVIII, 1906, p. 112, pl. 26, fig. 32.
Zootecus chion, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 373.

The shell is moderately small, oblong, more or less broadly cylindrical for the most part, but rather conical and pointed towards the apex, the shape of the shell being thus more or less pupiform. The spire is elongated and terminates in a conical apex above. The shell is solid, with the surface finely and closely transpirally striated throughout, and exhibiting a dull glossy finish. There are about seven to eight whorls, the body whorl being somewhat larger and about one-third of the total length of the shell ; it is well rounded below. The shell is narrowly perforate, the umbilicus being partly covered up by the reflected columellar margin. The aperture is vertical, more or less semiovate in outline, with the peristome slightly thickened with callus and blunt-edged. The columellar margin of the aperture is rather short, and somewhat expanded and reflected. The sutures are only moderately impressed and the whorls slightly convex. The shell is uniformly whitish.

Recorded localities : Karachi, Punjab, Kutch, Soliman Range, Umarkote, Sind, Saharunpore, Afghanistan and Hyderabad. It is significant to note that this species had not so far been recorded from places farther south than Hyderabad, but the Madras Museum collection contains several specimens from Pamban and Coimbatore in South India.

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Specimens in the collection : Seven specimens from Pamban and six from Coimbatore—all dry-preserved empty shells, more or less uniformly dirty white in colour, and several spirit-preserved specimens, paler below and straw-brown towards the apex collected by the late Prof. Barnes from Jammalamadugu, Chingleput District. Average measurements : Height : 12 mm. ; maximum diameter : 5 mm. ; aperture : oblique height : 4.5 mm. ; maximum diameter : 3 mm. These measurements are almost identical with those of the type specimen quoted by Gude (*loc. cit.*). Specimens of this species from Hyderabad, in the collections of the British Museum are reported to be much larger, measuring as much as 14 mm. high and 6 mm. wide at their broadest part. The specimens from Pamban have been presumably collected from interior localities well away from the shore line.

Family ACHATINIDAE

The shell ranges from a moderate to very large size, usually ovately conical, rarely cylindrical, often with feeble striations and without internal lamellae. The columella is either straight or concave, usually truncated below, seldom dilated at the lower margin.

Genus **Achatina** Lamarck, 1799

(Syn. **Ampulla** (part) (Bolten) Röding, 1798)

The shell is more or less elongately ovate, with a conical spire. Two or three of the uppermost whorls are small, smooth and conical, terminating in the obtuse apex above. The aperture is ovate and the columella truncated below. The outer lip is unexpanded.

This genus is represented in India by only a single species, *Achatina fulica* (Férussac), which is a native of Madagascar, but had been subsequently introduced into India and Ceylon, and other places such as Mauritius and Bourbon. Although it is not indigenous to India, it has now firmly established itself in India and Ceylon, and in certain localities living specimens are found in great abundance. They are oviparous, laying numerous small, oval, pale yellow eggs.

Achatina fulica (Férussac)

Plate X, figs. 1*a* and 1*b*

Helix fulica, Férussac, Tabl. Syst. Limacons, 1821, p. 49, No. 347 (nom. nud.).
Achatina fulica, Deshayes, Anim. sans vert., ed. 2, VIII, 1838, p. 297 (foot-note).
Achatina fulica, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 254.
Achatina fulica, Reeve, Conch. Icon., V, 1849, *Achatina*, pl. 2, fig. 8 ; pl. 3, fig. 8*b*.
Achatina fulica, Deshayes, in Férussac, Hist. Nat. Moll., II, part 2, 1851, p. 162.
Achatina fulica, Benson, Journ. de Conchyl., VII, 1858, p. 266.
Achatina fulica, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 145.
Achatina (*Achatinus*) *fulica*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 266.
Achatina fulica, Pilsbry, Man. Conch., ser. 2, XVII, 1904, p. 55, pls. 36 and 37.
Achatina fulica, Annandale, Rec. Ind. Mus., I, 1907, p. 176.
Achatina fulica, Gude, Faun. Brit. India, Mollusca, II, 1914, p. 340.
Achatina fulica, Paiva, Rec. Ind. Mus., XVI, 1919, pp. 21 and 23.
Achatina fulica, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 149 (fig. 35).

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The shell is considerably large, ovately conoid, with a rather strongly inflated body whorl and a more or less convexly conical spire. The whorls are eight in number, somewhat convex and inflated, the body whorl being comparatively large and elongately ovoid and nearly equalling half the entire length of the shell. The sutures are well impressed and the apex is rather obtuse. The aperture is large and elongately ovate, with the peristome straight and acute. The margins of the peristome are connected by a callus layer. The columella is slightly concave, rather twisted, and narrowly truncated below. The surface of the shell is somewhat glossy and appears practically smooth, but there is a fine sculpture of close-set transpiral striae which are irregularly decussated with fine spiral striations on the whorls of the spire, and near the sutures the transpiral striations are rather more strongly marked and appear as fine crenulations. The two or three uppermost whorls of the spire are more or less entirely smooth and glossy, terminating in the obtusely rounded apex above. The shell is pale yellowish, irregularly streaked and clouded with brownish markings all over, but the uppermost whorls of the spire are generally whitish and devoid of colour markings. The aperture is white or bluish white within. The brownish markings on the surface generally tend to take the form of irregular, transpirally elongated bands.

Hornell (*loc. cit.*) has referred to the occurrence of this species in Ceylon. It was introduced into Ceylon some years ago and has now become a well established pest, causing considerable damage to vegetable gardens. It is said to attain a length of five inches in Ceylon. Its eggs are bright yellow and about one-tenth of an inch in diameter. In Bengal it has been established for nearly 100 years and is said to occur commonly in Calcutta gardens. Paiva (*loc. cit.*) refers to the interesting fact that *Achatina fulica* is preyed upon by the Indian glow worm, the larva of *Lamprophorus tenebrosus*.

Recorded localities : India : Calcutta (introduced) ; Mauritius and Bourbon (introduced) ; Madagascar, Mascarenes, Seychelles, Comoro Islands, Zanzibar ; Ceylon (introduced).

Specimens in the collection : Four large spirit-preserved specimens with the soft parts intact, from Ceylon, and a single, moderate-sized, empty dry shell with the colouration fairly fresh, in late Mr. Crichton's duplicate collection (donated to the Museum). The locality of this specimen is doubtfully recorded as Ceylon. The shell is creamy yellowish, glossy, with clouded, brownish markings all over. Measurements : Height : 76 mm. ; maximum diameter : 38 mm. ; aperture : height : 36 mm. ; maximum diameter : 19 mm. These measurements are considerably smaller than those of the Calcutta specimens cited by Gude (*loc. cit.*).

SERIES ZONITACEA

Family ENDODONTIDAE

The shell is small, often umbilicated, uniformly brownish or streaked with flame-like markings, smooth or striated, and with a low, depressed spire. The body whorl is evenly rounded or keeled and the aperture is sometimes toothed.

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Sub-family ENDODONTINAE

The shell is small to moderate-sized, of variable form, usually perforate and with a moderately low spire, sometimes conical, rarely cylindrical, smooth or ribbed.

Genus **Thysanota** Albers, 1860

The shell is narrowly perforate, broadly conical and more or less trochiform, the whorls being only slightly inflated. The body whorl is conspicuously keeled. The aperture is angularly semi-ovate in outline, and is devoid of teeth. The peristome is simple and acute and the columellar margin twisted in front.

Thysanota guerini (Pfeiffer)

Plate X, figs. 2*a* to 2*c*

Helix guerini, Pfeiffer, Rev. Zool., 1842, p. 304.
Helix guerini, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 85, fig. 457.
Helix guerini, Hanley & Theobald, Conch. Indica, 1876, p. 25, pl. 55, fig. 1.
Thysanota guerini, Theobald, Cat. Shells Brit. India, 1876, p. 26.
Nanina (*Thysanota*) *guerini*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 54.
Trochomorpha guerini, Kobelt, III, Conch. Buch., 1879, pl. 68, fig. 11.
Trochomorpha (*Thysanota*) *guerini*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 82.
Helix (*Thysanota*) *guerini*, Tryon, Man. Conch., ser. 2, III, 1887, pl. 93 ; pl. 18, figs. 95 and 96.
Eulota (*Thysanota*) *guerini*, Pilsbry, Man. Conch., ser. 2, IX, 1895, p. 208.
Thysanota guerini, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1907, pp. 188 and 190.
Thysanota guerini, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 11.

The shell is moderately small, depressed, broadly conical, trochiform and umbilicated. The shell, when fresh, is covered with a brownish periostracum, densely beset with bristly hairs over the area of the spiral keel on the body whorl. The whorls are about seven in number, with flattened walls, and scarcely convex. The body whorl is strongly keeled and angulated round the periphery and the basal portion of the shell, below the keel, is rather convex. The apex is somewhat obtuse. The aperture is wide, semi-lunate and rather strongly angulated in the region of the keel. The umbilicus is narrow, but deep. The peristome is simple with a thin marginal callus. The surface of the shell is throughout closely transpirally striated, these striae being stronger and more pronounced on the basal surface of the shell. The general appearance of the shell recalls that of a rather depressed shell of *Trochus*.

Recorded localities : India : Nilgiris, Anamalais, Southern India. This species is said to inhabit the summits of the hills in the Nilgiris.

Specimens in the collection : A single empty shell from the Nilgiris. The surface of the shell is bleached almost white, but traces of the original brownish periostracum are seen on portions of the surface, especially on the basal surface and around the keel towards the apertural edge. Measurements : Diameter : major : 13 mm. ; minor : 12 mm. ; altitude : 7.5 mm. The shell is considerably smaller than that of the type specimen cited by Gude (*loc. cit.*) and is apparently not a full-grown specimen.

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Genus **Ruthvenia** Gude, 1911

(Syn. **Austenia** Gude, 1897, non Nevill, 1878 ;

Sykesia Gude, 1897, non Pomel, 1883)

The shell is more or less widely umbilicated, dextral, translucent, and somewhat depressedly conical. The body whorl is acutely keeled. The outer surface of the shell bears distinct, fringed, spiral striae. The aperture is moderately narrow, bearing on the inside of the body whorl a parietal armature consisting of one or two oblique lamellae ; a palatal armature of denticles is also present.

Ruthvenia retifera (**Pfeiffer**)

Plate X, figs. 3*a* to 3*c*

Helix retifera, Pfeiffer, Proc. Zool. Soc. London, 1845, p. 73.
Helix retifera, Reeve, Conch. Icon., VII, 1853, *Helix*, pl. 173, fig. 1170.
Helix retifera, Hanely & Theobald, Conch. Indica, 1876, p. 37, pl. 87, figs. 8 and 9.
Plectopylis retifera, Theobald, Cat. Shells Brit. India, 1876, p. 25.
Helix (*Plectopylis*) *retifera*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 70.
Helix (*Plectopylis*) *retifera*, Tryon, Man. Conch., ser. 2, III, 1887, p. 161, pl. 34, figs. 63 and 64.
Plectopylis retifera, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 146.
Plectopylis retifera, Gude, Science Gossip, N.S., III, 1897, p. 301, fig. 43 (shell and armature).
Plectopylis (*Sykesia*) *retifera*, Gude, Science Gossip, N.S., VI, 1899, p. 149.
Helix retifera, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1907, p. 201.
Ruthvenia retifera, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 26.

The shell is rather small, umbilicated, obtusely trochiform, and more or less in the form of a thick, biconvex disc, the basal surface of the body whorl being almost as strongly convex and inflated as the upper aspect of the shell. The shell is rather translucent and the body whorl is distinctly keeled at the periphery. The whorls are about six to seven in number, with rather flattened walls. The spire is somewhat elevated but rather broad and obtuse. The umbilicus is moderately large and open. The aperture is narrow, depressed and more or less wedge-shaped or crescent-shaped. The peristome is simple, thin and acute, its upper margin above the site of the keel being short and straight and its basal margin rather depressedly arched. The sculpture consists of a distinct double spiral ridge on each whorl, decussated by numerous obliquely transpiral close-set striations. The shell is pale horny brown in colour, and rather glossy on the basal surface. A distinct parietal armature consisting of a single, strong, vertical, slightly sinuate plate and a palatal armature composed of two series of denticles are present. Gude (*loc. cit.*) has described these armatures in detail. The surface of the shell is covered by a fine silky periostracum in the fresh condition.

Recorded localities : India : Nilgiris, Coonoor Ghat ; Tinnevelly Hills, Shevroy Hills, Mysore.

Specimens in the collection : Seven dry-preserved shells from Shevroy Hills, one of which is a young specimen, being about half the size of the adult shells. Remnants of a brownish periostracum are present on the upper surface in some of the shells. Average measurements of the adult shell : Diameter : major : 7.5 mm. ; minor : 7 mm. ; height : 4 mm.

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Family CORILLIDAE

The shell is widely umbilicated, and the spire depressed and flattened or only slightly elevated. The aperture is oblique, with the peristome expanded and reflected, as a rule with an entering lamella, and usually also with lamellae on the interior of the body whorl.

Genus **Corilla** H. & A. Adams, 1855

[Syn. **Atopa** Albers, 1850 (part)]

The shell is very widely umbilicated, disc-shaped, *Planorbis*-like in appearance, brownish, moderately thick, and obliquely transpirally striated on the surface. The body whorl is rounded and downwardly inclined towards the apertural end. The aperture is oblique and the peristome expanded, reflected and thickened with callus. The parietal wall is smooth or with a strong, entering lamella and the interior of the body whorl often with transverse or somewhat oblique lamellae.

About ten species of this genus are recorded by Gude in the Fauna of British India volume on Mollusca (II, 1914), all of which are known only from Ceylon, except one species, *Corilla anax*, which is also recorded from South India, but unfortunately this species is not represented in the Museum collection. All the six species of which specimens are represented in the Museum collection are recorded only from Ceylon, and the diagnostic key given by Gude on p. 55 of his volume on Mollusca cited above will be found helpful in distinguishing these species.

Corilla adamsi Gude

Plate X, figs. 4*a* and 4*b*

Helix charpentieri, Pfeiffer, Proc. Zool. Soc. London, 1853, p. 127.
Helix charpentieri, Reeve, Conch. Icon., VII, 1854, *Helix*, pl. 185, fig. 1285.
Helix charpentieri, Hanley & Theobald, Conch. Indica, 1876, p. 7, pl. 14, fig. 1.
Corilla charpentieri, Theobald, Cat. Shells Brit. India, 1876, p. 24.
Helix charpentieri, Brot, Journ. de Conchyl., XII, 1864, p. 22, pl. 2, fig. 11.
Corilla charpentieri, Frauenfeld, Verh. K.-K. Zool.-bot. Ges., XIX, 1869, p. 876.
Corilla charpentieri, Gude, Science Gossip, N.S., III, 1896, p. 88, fig. 1.
Helix (*Corilla*) *charpentieri*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 70.
Helix (*Atopa*) *charpentieri*, Tryon, Man. Conch., ser. 2, III, 1887, p. 156, pl. 33, figs. 9 and 10.
Corilla adamsi, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 56.

The shell of this species may be readily distinguished from those of all other known species of *Corilla* by the total absence of internal folds in the mature, full-grown shell. The shell is widely and openly umbilicated, depressed and discoidal, fairly thick and solid, with the surface traversed by close-set, strong, rib-like, obliquely transpiral striations throughout. The spire is slightly concavely depressed and the sutures are well impressed. The whorls are six in number, rather narrow, rounded and moderately convex. The body whorl is well rounded and downwardly inclined towards the free end. The aperture is nearly circular in outline, and is strongly oblique, being almost horizontal with the lip thickened with callus and broadly expanded and reflected. On the inner side the margins of the peristome are approximated. The umbilicus

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is rather deep and more or less funnel-shaped. The surface of the shell is covered by a glossy, horny or olive-brown periostracum when fresh. The peristome and the interior of the aperture are whitish. The adult shell is totally devoid of internal folds and lamellae, but in the earlier stages the shell is furnished with palatal laminae as in the young shells of other species of *Corilla*.

Recorded localities : Ceylon ; Nanu Oya jungle, Ceylon.

Specimens in the collection : A single adult, dry-preserved shell from Udugama, Ceylon. The shell is pale horny brown, with a few remnants of the original brownish periostracum here and there. Measurements : Diameter : major : 24 mm. ; minor : 19.5 mm. ; height : 8 mm.

Corilla beddomeae (Hanley)

Plate X, figs. 5*a* to 5*c*

Helix (*Plectopylis*) *Beddomeae*, Hanley & Theobald, Conch. Indica, 1876, p. 60 (no description), pl. 150, figs. 1 and 2.
Plectopylis beddomei, Pilsbry, Man. Conch. ser. 2, IX, Index, 1895, p. 121.
Corilla beddomeae, Gude, Science Gossip, N.S., III, 1896, p. 127, figs. 13 and 14.
Corilla beddomeae, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 57.

The shell is considerably smaller and more strongly depressed than that of the preceding species. It is widely and openly umbilicated, discoidal, with the spire flattened and absolutely horizontal. The sutures are only slightly impressed. The whorls are about six in number, quite flattened above, but somewhat rounded and inflated below. The body whorl is bluntly keeled, or rather, angulated above the periphery and is slightly expanded and abruptly downwardly inclined towards the free apertural end. The aperture is strongly oblique, and more or less broadly squarish in outline, its upper and lower margins being almost straight, and its outer margin curved. The lower margin is specially thickened with a whitish callus deposit. The columellar margin of the aperture bears a thin callus ridge connecting the margins of the peristome and from this ridge arises medially a strong, sinuous entering lamella ; posteriorly this lamella descends downwards and below this posterior part of the lamella occurs a second, rather thinner, flexuous horizontal fold. The interior of the wall of the body whorl bears four palatal folds. The sculpture of the shell is very characteristic : it consists of rather coarse, irregular, transpiral striae, which, on the body whorl and the next two or three whorls above it, are intermixed here and there with strong, obliquely descending wrinkled ridges. The lower aspect of the shell is finely striated and more or less glossy. The shell is dark chestnut brown, the interior of the aperture being paler and more or less fleshy brown. The shell of this species is readily distinguished from those of other species of *Corilla* by its coarse, wrinkled and irregular sculpture and by its being much flattened above.

Recorded localities : Ceylon : Haycock Mountain, Ambegamuwa, Watawala and Newara Eliya. This species is said to be rare in Museum and private collections.

Specimens in the collection : A single dry shell from Dimbula, Ceylon ; it is chestnut brown above, slightly paler brown and more or less glossy below. Gude, in his description of the species, (*loc. cit.*, 1914), states that the transpiral striae are intermixed with oblique, wrinkled ridges only

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on the body whorl, but in the specimen examined, these wrinkled oblique ridges are present also on two or three of the lowermost whorls of the spire, in addition to the body whorl. Measurements : Diameter : Major : 18.5 mm. ; minor : 14.5 mm. ; height : 6 mm. These measurements are within the range of size cited by Gude (*loc. cit.*) for this species.

Corilla gudei Sykes

Plate XI, figs. 1*a* to 1*c*

Corilla gudei, Sykes, Proc. Malacol. Soc. London, II, 1897, p. 234, pl. 16, figs. 8–10.
Corilla gudei, Godwin-Austen, Land and Freshwater Mollusca of India, II, 1907, p. 199, pl. 114, fig. 3 (anatomy).
Corilla gudei, Gude, Fauna Brit, India, Mollusca, II, 1914, p. 80.

The shell is depressed, discoidal and more or less oblong ovoid in outline, the excess of the major diameter over the minor being comparatively much greater than in the preceding species. The body whorl is strongly inclined downwards towards the free apertural end, and rather markedly compressed in the region where the lamellae on the outer wall show most clearly through the shell. The sculpture consists of fairly strong, close-set, obliquely transpiral ridge-like striae, more or less uniformly developed and almost equally strong on the upper and lower surfaces. The upper surfaces of the whorls are completely flattened, the spire being absolutely flat and horizontal, but on the lower aspect, the whorls are rather rounded and inflated. The aperture is very oblique, broadly rounded in outline, with the peristome strongly expanded and reflected. There is a strong, entering lamella from the columellar margin of the aperture ; this lamella ascends obliquely at first, but posteriorly it curves strongly downwards, and below this posterior curved part, there is a second thinner fold running almost parallel to it. The palatal folds on the inside of the outer wall of the body whorl are well developed and are disposed almost in the same manner as in *C. erronea* and *C. fryae*. The umbilicus is very wide and open. The shell is more or less uniformly olive-brown in colour. This species is readily distinguished from the other Ceylon species of this genus in the sculpture of the shell being more or less equally strongly developed on both the upper and lower surfaces.

Recorded localities : Ceylon : Karunegala.

Specimens in the collection : A single dry-preserved shell from Kegalle, Ceylon. The shell is typical, somewhat lighter brown below than above. The lower surface is also slightly glossy. The lower margin of the apertural lip is specially thickened with callus deposit. Measurements : Diameter : major : 23.5 mm. ; minor : 16.5 mm. ; height : 7.5 mm.

Corilla fryae Gude

Plate XI, figs. 2*a* and 2*b*

Corilla fryae, Gude, Science Gossip, N.S., III, 1896, p. 89, figs. 2, 4, 5 and 6.
Corilla fryae, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 64.

The shell is rather large, ovately rounded in outline, discoidal, and very widely umbilicated, the umbilicus being comparatively more open and shallow than in the preceding species. The spire is flattened and almost perfectly horizontal, with the sutures only slightly impressed. The

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whorls are flattened above but moderately convex and rounded below. The body whorl is distinctly angulated, or almost keeled midway between the suture and the periphery. The body whorl is also somewhat compressed at some distance from the apertural end, but abruptly widens towards the aperture and again becomes rather constricted just behind the peristome. It is strongly inclined downwards towards the apertural end. The sculpture consists of rather fine, close set and regular, obliquely transpiral striae, which are much stronger above than below. The surface of the shell is rather dull above, but highly glossy below. The aperture is oblique, more or less broadly squarish or rather D-shaped in outline, the upper and lower margins being straight, but the outer curved. The peristomial edge is expanded and strongly reflected. At the inner columellar border, the margins of the peristome are connected by a thick whitish callus ridge from which arises the strong, entering lamella, this being the most elongate and the median one among the parietal folds of which there are three, the two lateral ones being much thinner and more deeply set. The palatal folds are four in number and rather elongated and flexuous. The basal margin of the peristome is thickened into a distinct, elongately quadrate, callus tooth. Immature shells contain a greater number of palatal folds. They are distinctly visible through the shell wall, especially when the shell is held against the light. The shell is bright horny or almost rufous brown. The peristome and interior of the aperture are white.

Recorded localities : Ceylon : Albion Estate, Lindula District ; Ambegamuwa.

Specimens in the collection : A single dry-preserved shell from Dimbula, Ceylon. It is typical, full-grown, rather coarse and dull above, but highly glossy and of a bright greenish brown colour on the lower surface. Measurements : Diameter : major : 28 mm. ; minor : 21.5 mm. ; height : 9 mm. These measurements are slightly larger than those of the type cited by Gude (*loc. cit.*).

Corilla erronea (Albers)

Plate XI, figs. 3*a* to 3*c*

Helix rivoli, Pfeiffer (non Deshayes), Mon. Helic. Viv., I, 1848, p. 407.
Helix Rivolii, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 78, fig. 413.
Helix erronea, Albers, Zeits. Malak., X, 1853, p. 107.
Helix erronea, Brot, Journ. de Conchyl., XII, 1864, pl. 2, figs. 7–9.
Anchistoma (*Corilla*) *erroneum*, Adams, Genera of Recent Mollusca, II, 1855, p. 208.
Corilla erronea, Semper, Reisen Arch. Philippinen, Wiss. Res. 2, III, 1870, p. 100, pl. 12, fig. 18 ; pl. 16, fig. 4 (anatomy).
Helix erronea, Hanley & Theobald, Conch. Indica, 1876, p. 7, pl. 14, fig. 3.
Corilla erronea, Theobald, Cat. Shells Brit. India, 1876, p. 24.
Corilla erronea, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 148, pl. 41, fig. 19 (armature) ; pl. 42, figs. 37 and 38 (anatomy).
Corilla erronea, Gude, Science Gossip, N.S., III, 1896, p. 89, fig. 3, p. 90, fig. 7 (shell and armature).
Helix (*Corilla*) *erronea*, Nevill, Hand List Moll., Ind. Mus., 1878, p. 70.
Helix (*Atopa*) *erronea*, Tryon, Man. Conch., ser. 2, III, 1887, p. 157, pl. 33, figs. 19–21.
Corilla erronea, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 66.

The shell is smaller than in the preceding species, discoidal, somewhat elongately rounded in outline, horizontally flattened, and even slightly depressed and concave above, and with a very wide, open and comparatively shallow umbilicus. The surface of the shell is sculptured

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with coarse, obliquely transpiral, rather irregular, rib-like striae, but the lower surface of the shell (especially of the body whorl) is comparatively smooth and glossy. The whorls are five in number, with the sutures well impressed. The body whorl is somewhat expanded and only slightly inclined downwards towards the free apertural end. The aperture is strongly oblique, rather broadly squarish or more or less D-shaped. The peristome is thickened and reflected, its inner margins being connected by a thin, whitish callus from which arises a strong, entering lamella which ascends obliquely upwards at first and distally curves down again. The basal margin of the peristome is thickened into a tooth-like, oblong callosity. The palatal plates are four in number and are disposed in much the same manner as in *C. fryae*, but in the present species they are shorter and less strongly curved. The shell is more or less reddish brown or rusty brown above, and of a much lighter olive-brownish colour below.

Recorded localities : Ceylon : Newara-Eliya ; Upper Owvah, Pusilawe, Bandarewella.

Specimens in the collection : A single dry-preserved shell from Watawala, Ceylon. The lower surface of the body whorl is almost smooth and glossy, but the lower surfaces of the other whorls bear fairly strong, obliquely transpiral rib-like striae, but weaker than on the upper surface. Measurements : Diameter : Major : 23 mm. ; minor : 18 mm. ; height : 7 mm. Gude's major diameter of 15 mm. for this species (*loc. cit.*) is obviously an error, and might have been a misprint for " 25 mm. ".

Corilla carabinata (Férussac)

Plate XI, figs. 4*a* to 4*c*

Helicodonta carabinata, Férussac, Tabl. Syst. Limacons, 1821, p. 38, No. 109.
Helix carabinata, Férussac, Hist. Nat. Moll. Expl. Planches, 1822, p. iii, pl. 51 B, fig. 3 (shell and armature).
Helix carabinata, Deshayes, Anim. sans vert., ed. 2, VIII, 1838.
Helix rivolii, Deshayes, Encyclopédie Méthodique, Vers. II, 1830, p. 208.
Helix Rivolii, Reeve, Conch. Icon., VII, 1854, *Helix*, pl. 185, fig. 1284.
Anchistoma (*Atopa*) *rivolii*, Chenu, Man. de Conchyl., I, 1860, p. 463, figs. 3452–54.
Helix rivolii, Brot, Journ. de Conchyl., XII, 1864, pl. 2, fig. 10.
Helix Rivolii, Hanley & Theobald, Conch. Indica, 1876, p. 7, pl. 14, fig. 2.
Corilla Rivolii, Theobald, Cat. Shells Brit. India, 1876, p. 24.
Helix (*Corilla*) *rivolii*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 70.
Corilla rivolii, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 148, pl. 41, figs. 20–22.
Corilla rivolii, Gude, Science Gossip, N.S., III, 1896, p. 91, figs. 8 and 9 (shell and armature).
Helix (*Atopa*) *rivolii*, Tryon, Man. Conch., ser. 2, III, 1887, p. 156, pl. 33, figs. 11 and 12.
Corilla carabinata, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 67.

This species has been better known to authors as *C. rivolii*, but Férussac's name *carabinata* has priority over the former. The shell is discoidal, rather ovately rounded in outline, very widely and openly umbilicated, and concavely depressed above. The whorls are six in number, slightly inflated both above and below, the sutures being well impressed. The shell is sculptured with strong, close-set, obliquely transpiral ridges on the upper surface, but the sculpture on the body whorl stops abruptly a little distance below the suture, the periphery and the lower surface being practically smooth, although fine, oblique striae are present on the lower surfaces of the whorls of the spire and just behind the peristomial margin on the body whorl. The body whorl is rather

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strongly compressed some distance from the aperture, but from this point onwards it widens out considerably in a trumpet-shaped manner towards the apertural end where it slightly dips downwards. The aperture is very strongly oblique, almost horizontal, and widely semi-circularly rounded in outline. The peristome in this species is more strongly expanded and reflected than in any of the preceding species of this genus. The inner margins of the peristome are connected by a thick, whitish callus, from which arises the strong, plate-like entering lamella. The general disposition of the parietal and palatal folds is much the same as in the preceding species. Immature shells contain as many as five palatal plates. The shell is pale straw-brown in colour, the interior of the aperture being smooth, glossy and whitish.

Recorded localities : Ceylon : Kandy, Mupane.

Specimens in the collection : One dry-preserved shell from Kandy, Ceylon, pale brownish white in colour, and strongly and closely obliquely striated on the upper surface. Measurements : Diameter : Major : 25 mm. ; minor : 18 mm. ; height : 7.5 mm. These measurements are almost identical with those of the type specimen cited by Gude (*loc. cit.*).

SERIES ARIOPHANTACEA

Family ARIOPHANTIDAE

The Ariophantidae constitutes a distinct and important family of Indian land Mollusca and is almost exclusively confined to Peninsular India and Ceylon. The largest Indian land shells belong to this family.

The shell is very variable in form, size and thickness and may be either dextral or sinistral. It is generally helicoid, inflated, globose or turbinated and ranges from thin, translucent, membranaceous, to solid forms of considerable size and thickness.

The species of Ariophantidae represented in the Museum collection belong to eight different genera which are rather difficult to distinguish solely by external characters of the shell. However, it is hoped that the following key, based mainly on shell characters and external appearances, will be of some help in recognizing these eight genera of this large and confusing group.

1. Shell internal, calcareous, plate-like, elongately ovate, not coiled ; animals slug-like ... ... *Mariaella.*

— Shell external, coiled, either horny or calcareous ; shell variable in form and size. Animals snail-like ... 2.

2. Shell large, very thin, partly membranaceous, fragile, with few whorls ; aperture very large and obliquely oval ; animal somewhat larger than the shell and not completely retractile within the shell ... ... *Indrella.*

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— Shell generally smaller, thicker and more solid, usually more strongly calcareous ; shell with numerous whorls and comparatively larger spire and smaller aperture ; animal not larger than the shell, and more or less completely retractile within the shell (except in the genus *Macrochlamys*) ... ... 3.

3. Shell sinistral ... ... *Ariophanta.*

— Shell dextral ... ... 4.

4. Shell very small, seldom exceeding about 3½ mm. in diameter, as a rule conical or trochiform, with angular body whorl ... ... *Kaliella.*

— Shell much larger, almost always exceeding 3½ mm. in diameter, generally more rounded, globose or turbinated and body whorl not, as a rule, angulated ... 5.

5. Shell large and thick, with the whorls uniformly increasing in size, the upper surface being more or less convex and usually wrinkled. The body whorl is often keeled (at least in the two species represented in the Museum collection, which are the more common among the Indian forms of this genus) ... ... *Hemiplecta.*

— Shell not as above, smaller and thinner, with the body whorl usually rounded, not keeled (except in *Euplecta* which is distinguishable by other characters such as the more closely wound whorls and lenticular or conoid shape of the shell) ... ... 6.

6. Shell mostly solid, more or less similar to *Ariophanta* in shape and proportions (except that it is dextral here, instead of being sinistral), convexly inflated above, often spirally banded with coloured bands ; surface obliquely striated ; aperture more or less wide and oblique ... *Cryptozona.*

— Shell generally thinner and smaller, more depressed, subglobose or subturbinated ; usually uniformly coloured, without spiral bands : shell generally striated above (though sometimes only very finely) and smoother and more polished below ; aperture moderately wide and broadly crescent-shaped, with the columellar margin reflected at the umbilicus. ... ... 7.

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7. Shell thin, horny, as a rule smooth and polished, especially beneath, occasionally distinctly and often microscopically striated, or decussately sculptured. Body whorl generally rounded, not keeled or angular... *Macrochlamys.*

— Shell thicker, more calcareous, rather more closely wound, lenticular or conical, usually with rib-like striae above, and sometimes with rows of bead-like tubercles on the ribs. Body whorl often keeled or angular below ... ... *Euplecta.*

Sub-family KALIELLINAE

The shell is small, not at all or only narrowly perforate, more or less inflated and with usually indistinctly striated whorls, the body whorl being rounded or angular.

Genus **Kaliella** Blanford, 1863

The shell is of variable height, often conical, and with angular body whorl, sometimes only slightly inflated, and often with oblique, rib-like striae on the surface. The peristome is thin.

Kaliella barrakporensis (Pfeiffer)

Plate XI, fig. 5

Helix barrakporensis, Pfeiffer, Proc. Zool. Soc. London, 1852, p. 156.
Helix barrakporensis, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 132, fig. 816.
Helix barrakporensis, Benson, Ann. & Mag. Nat. Hist., ser. 3, III, 1859, p. 272.
Helix barrakporensis, Blanford, W. & H., Journ. Asiatic Soc. Bengal, XXX, 1861, p. 358.
Helix barrakporensis, Blanford, Ann. & Mag. Nat. Hist., (3), XI, 1863, p. 83.
Helix barrakporensis, Hanley & Theobald, Conch. Indica, 1876, p. 37, pl. 87, fig. 7.
Kaliella barakporensis, Theobald, Cat. Shells Brit. India, 1876, p. 20.
Nanina (*Microcystis* ?) *barrakporensis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 41.
Kaliella barrakporensis, Godwin-Austen, Land & Freshwater Mollusca of India, I, 1882, pp. 2 and 19 ; pl. 1, figs. 1–4 (shell) ; pl. 2, fig. 1 (shell) ; pl. 5, fig. 11 (radula) ; 1883, p. 146, pl. 38, fig. 5 (genitalia).
Helix sivalensis, Godwin-Austen, ibid., pl. 1, figs. 3 and 3*a* ; pl. 2, fig. 1 (shell).
Kaliella barakporensis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Kaliella barrakporensis, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 258.
Kaliella barrakporensis, Annandale, Rec. Ind. Mus., VII, 1912, p. 35.

The shell is small, somewhat conically trochiform, thin, fragile and sculptured with very fine, almost microscopic, close-set ribs on the upper surface while the basal surface is traversed by closely set, fine, impressed spiral lines. The spire is rather high and conical with slightly convex sides. The sutures are moderately well impressed. The whorls are five and half to six in number, convex, gradually and regularly increasing in size from above downwards, the body whorl being keeled and convexly inflated below. The aperture is oblique, somewhat squarely crescent-shaped. The peristome is simple, thin and straight, with the columellar margin slightly oblique and reflected over the umbilicus. The shell is rather translucent and horny—

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or umber-brown in colour. Godwin-Austen (*loc. cit.*) has described in detail the radula and genitalia of this species, while Ramanan (*loc. cit.*) has referred briefly to the habits of the living animal of this species. They frequent humid situations such as the sides of flower pots and beneath rotting logs of wood and among decaying leaves in gardens. At the approach of the hot season, they aestivate by attaching themselves by a thin mucus film to the under-surfaces of fallen and decaying leaves.

Recorded localities : This is a widely distributed species, and has been recorded from a wide range of localities, including Burma, Ceylon, and Madagascar. Among the more important localities from which this species has been recorded within India, mention may be made of the following : Paresnath Hills, Barrakpore, Teria Ghat, near Calcutta ; Khandalla, near Bombay ; Madras, Salem, Patchamullay and Kalrycumullay Hills ; Barisal, Bengal ; near River Megna, Lower Bengal ; Mussoorie, N.W. Himalayas, Kashmir and Sikkim. It has been previously recorded from Madras City for the first time by Ramanan (*loc. cit.*).

Specimens in the collection : A single dry-preserved, rather mutilated specimen and seven spirit-preserved specimens with pale, translucent brownish shells, with their soft parts intact, all from Madras. Average measurements : Height : 3.5 mm. ; diameter : 3.5 mm. ; but the proportion of the height to the diameter varies, the height being often slightly less than the diameter, at the base.

Sub-family MACROCHLAMYDINAE

The shell is of variable size, rather depressedly inflated, smooth or striated and the body whorl is either rounded or keeled.

Genus **Macrochlamys** (Benson, 1832) Gray, 1847

(Syn. **Tanychlamys** Benson, 1834 ;

Orobia Albers, 1860)

The shell is usually narrowly umbilicated, moderately convex above, smooth or finely sculptured. The aperture is moderately wide, broadly crescent-shaped. The peristome is thin, rarely somewhat thickened on the inside, and is reflected over the umbilicus. Mantle as a rule with right and left shell lobes.

The genus *Macrochlamys* includes many of the commonest species of Indian land snails. They abound mostly in the damper parts of the country and are often difficult to separate by external characters of the shell alone. The animals are large and active, and in the rainy season, they are scarcely retractile within the shell.

Four species of *Macrochlamys* are represented in the Museum collection, three of which are fairly common in South India, especially on the hills. They may be roughly recognized as follows :

1. Shell subglobosely depressed or sub-turbinate, very thin, dull above and not appreciably glossy ... ... *M. lixa.*

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— Shell depressedly conoid, slightly thicker : generally smooth and polished ... ... 2.

2. Shell very narrowly umbilicated, with fine spiral striation only ... ... *M. woodiana.*

— Shell openly perforate, smooth, or with very minute transpiral striations ... ... 3.

3. Shell with five whorls, moderately thin, attaining a size of over 12 mm. in diameter ... ... *M. aulopsis.*

— Shell with six whorls, very thin, fragile, translucent and glossy, seldom exceeding 8 mm. in diameter ... *M. vilipensa.*

Macrochlamys aulopsis (Benson)

Plate XI, figs. 6*a* and 6*b*

Helix aulopsis, Benson, Ann. & Mag. Nat. Hist., (3) XI, 1863, p. 318.
Helix aulopsis, Pfeiffer, Mon, Helic. Viv., V, 1868, p. 93.
Helix aulopsis, Hanley & Theobald, Conch. Indica, 1876, p. 15, pl. 30, figs. 8 and 9.
Trochomorpha aulopsis, Theobald, Cat. Shells Brit. India, 1876, p. 23.
Nanina aulopsis, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 32.
Macrochlamys aulopsis, Godwin-Austen, Proc. Zool. Soc. London, 1895, p. 446.
Macrochlamys aulopsis, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 128.

The shell is somewhat broadly and depressedly conical, being more or less trochiform in outline, and the walls of the whorls scarcely inflated and almost straight. The basal aspect of the body whorl is moderately inflated and convex. The whorls are five in number, regularly and gradually increasing in size from above downwards, forming a more or less straight-sided, broad, flattened cone. The sutures are only very slightly impressed. The body whorl is sharply keeled at the periphery, the portion below the keel being convex and more glossy. The shell is thin, translucent, pale horny brown, smooth and slightly polished. Fine, close-set, obliquely transpiral striae may be clearly seen under the lens throughout the surface of the shell. The aperture is oblique, rather broadly and squarely crescent-shaped. The peristome is thin and sharp-edged, while the columellar margin is slightly oblique and reflected over the umbilicus, above, in the form of a small, triangular, overlapping plate.

Recorded localities : Andaman Islands, Port Blair, Nicobars.

Specimens in the collection : It is interesting to note that although this species has so far been recorded only from the Andamans and Nicobars, a single, dry-preserved shell of this species from the Nilgiris, South India, identified by Dr. Baini Prashad, is represented in the Museum collection. It is of a dirty, brownish white colour, the convex, basal surface being whiter and more glossy. Measurements : Diameter : Major : 12.5 mm. ; minor : 11 mm. ; height : 7 mm. These dimensions are slightly larger than the typical measurements of the Andamans specimen cited by Blanford and Godwin-Austen (*loc. cit.*).

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Macrochlamys lixa (Blanford)

Plate XII, figs. 1*a* to 1*c*

Nanina (*Macrochlamys* ?) *lixa*, Blanford, Journ. Asiatic Soc. Bengal, 1866, II, p. 35.
Helix lixa, Pfeiffer, Mon, Helic. Viv., V, 1868, p. 79.
Helix lixa, Hanley & Theobald, Conchologia Indica, 1876, p. 59, pl. 149, figs. 5 and 6.
Macrochlamys lixa, Theobald, Cat. Shells Brit. India, 1876, p. 18.
Nanina lixa, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 26.
Macrochlamys ? *lixa*, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 131.

Unlike the preceding species, the shell in the present species is more or less turbinated and subglobose, the upper aspect being convexly rounded instead of being strictly conical in contour. The shell is narrowly perforate, very thin and translucent, dull above and glossy beneath. The surface is sculptured with fine, close-set, somewhat flexuous, obliquely transpiral, impressed lines, distinctly visible under the lens. The basal surface is comparatively smooth and glossy. The spire is somewhat depressed and broadly conoidal. The sutures are well impressed. The whorls are six in number, rather convex, the body whorl being well rounded and inflated beneath, and more or less distinctly angulated (but not sharply keeled as in the preceding species) at the periphery. The aperture is oblique, large, and somewhat broadly crescent-shaped. The peristome is thin, straight and sharp-edged and the columellar margin slightly oblique and somewhat reflected above so as to partly overhang the umbilicus. The shell is translucent and olive- or fulvous brown with an olive tinge.

Recorded localities : Anamullay Hills ; foot of the Pulney Hills ; Orissa and Ganjam. But Blanford and Godwin-Austen (*loc. cit.*) suspect that the locality originally given, *viz.*, Anamullay Hills, may be a mistake.

Specimens in the collection : Two dry-preserved shells from Pamban, Gulf of Manaar, South India, originally mislabelled as *Hemiplecta lixa* seem correctly referrable to the present species. This appears to be the first record of this species from a locality as far south as Pamban. Both the shells are bleached almost uniformly translucent whitish throughout, but the wavy transpiral striations on the upper surface are distinctly seen. Measurements : Diameter : Major : 14 mm. ; minor : 12.5 mm. ; height : 8.5 mm. These measurements are somewhat smaller than those of the type specimen cited by Blanford and Godwin-Austen (*loc. cit.*).

Macrochlamys woodiana (Pfeiffer)

Plate XII, figs. 2*a* to 2*c*

Helix woodiana, Pfeiffer, Proc. Zool. Soc. London, 1851, p. 254.
Helix woodiana, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 87.
Helix woodiana, Hanley & Theobald, Conch. Indica, 1876, p. 15, pl. 32, figs. 2 and 3.
Macrochlamys woodiana, Theobald, Cat. Shells Brit. India, 1876, p. 18.
Nanina (*Macrochlamys*) *woodiana*, Nevill, Journ. de Conchyl., XXVI, 1878, p. 60.
Nanina (*Macrochlamys* ?) *woodiana*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 22.
Helix woodiana, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 107, fig. 600.
Helix carneola, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 47.
Helix carneola, Pfeiffer, Proc. Zool. Soc. London, 1854, p. 148.
Helix carneola, Hanley & Theobald, Conch. Indica, 1876, p. 52, pl. 128, figs. 2 and 3.
Helix semifusca, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 62 (non Deshayes).
Macrochlamys ? *woodiana*, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 135.

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Blanford and Godwin-Austen (*loc. cit.*) place this and the succeeding species in a group of the species of *Macrochlamys* characterized by a depressed or conoidally depressed spire, and with the diameter of the shell not exceeding about 15 mm., and suggest that these species might possibly belong to the genus *Eurychlamys* Godwin-Austen, 1899, but since this and the succeeding species have six whorls and *Eurychlamys* is characterized by the presence of only three and half to five whorls, it seems safer to retain these species under *Macrochlamys*.

The shell is moderately small, depressed, almost discoidal, thin, smooth and glossy. The umbilicus is very narrow. The spire is low and rather depressed, the upper aspect of the shell being only very slightly convex. The sutures are well impressed. The whorls are six in number, gradually and regularly increasing in size from above downwards, the body whorl being only slightly larger than the preceding whorls and rather feebly and indistinctly angulated at the periphery. The lower aspect of the body whorl is slightly convex. The surface of the shell is practically smooth, but fine, microscopic, rather indistinct transpiral striae are present. The aperture is oblique, and broadly crescent-shaped, with the peristome thin, slightly arched towards the basal margin and with its columellar margin not reflected over the umbilicus. The colour of the shell is rather variable, but always pale, varying from a yellowish white to a pale horny brown. The surface of the shell exhibits a fine, translucent gloss all over.

Recorded localities : This is reported to be a common species in Southern India and Ceylon, and has been specifically recorded from the following localities : Ceylon ; Southern India : Tiruchirapalli, Kolamalai Hills, Arcot, Myhendra, Travancore.

Specimens in the collection : A single, dry-preserved shell from Callygoody, Tiruchirapalli, Southern India, identified by Dr. Baini Prashad. The lower whorls and basal surface are almost pure whitish, while the uppermost whorls are tinged dull horny brown. Measurements : Diameter : Major : 12 mm. ; minor : 11 mm. ; height : 5.5 mm. These measurements are identical with those of the type cited by Blanford and Godwin-Austen (*loc. cit.*).

Macrochlamys vilipensa (Benson)

Plate XII, figs. 3*a* and 3*b*

Helix vilipensa, Benson, Ann. & Mag. Nat. Hist., (2), XII, 1853, p. 93.
Helix vilipensa, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 49.
Helix vilipensa, Hanley & Theobald, Conch. Indica, 1876, p. 37, pl. 89, figs. 4, 5 and 6.
Macrochlamys vilipensa, Theobald, Cat. Shells Brit. India, 1876, p. 18.
Macrochlamys ? vilipensa, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 137.

The shell is much smaller than that of the preceding species, very thin, translucent and fragile, and smooth and glossy on the surface. The spire is slightly convexly raised, being somewhat less strongly depressed than in the preceding species. The shell is composed of six whorls, regularly enlarging from above downwards, with the sutures well impressed. The body whorl is rounded at the periphery, and rather convex and inflated on the basal aspect. The aperture is very slightly oblique and broadly crescent-shaped. The peristome is thin, with the columellar margin strongly arched and reflected above. The umbilicus is comparatively more open than in the preceding species. The shell is pale horny brown, or amber-coloured. Of the four species

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of *Macrochlamys* recorded in this report, the present species possesses the thinnest and most delicate shell.

Recorded localities : Mahintali, Ceylon ; Calcad Hills, Travancore, South India.

Specimens in the collection : A single, dry-preserved shell from Shevroy Hills, identified by Dr. Baini Prashad. It is interesting to note that this species has not so far been specifically recorded from Shevroy Hills by previous authors. The specimen in the collection is in a slightly broken condition. Measurements : Diameter : Major : 8 mm. ; minor : 7 mm. ; height : 4 mm. These measurements are identical with those of the type specimen cited by Blanford and Godwin-Austen (*loc. cit.*). The statement made by Blanford and Godwin-Austen (*loc. cit.*) that the shell of this species possesses two whorls is obviously an error, as there are actually six whorls, distinctly discernable in the present specimen.

Sub-family ARIOPHANTINAE

The shell is moderately or considerably large, usually narrowly umbilicated, dextral or sinistral, more or less inflated above. The body whorl is rounded or angular.

Genus **Euplecta** C. Semper, 1870

The shell is of moderate size, rather closely wound, usually narrowly umbilicated, lenticular or conoidal and trochiform, usually with rib-like striae above, sometimes with rows of tubercles on the ribs. The body whorl is often keeled, smoother below. The aperture is oblique, crescent-shaped, and the peristome is more or less reflected over the umbilicus.

It is rather difficult to distinguish the species of *Euplecta* solely by means of external characters of the shell alone, as shells of different species look closely alike ; however, the following key may help in some measure to recognise the species represented in the Museum collection which are among the more common species met with in Southern India :—

1. Shell trochiform, conical, with pointed apex, and rather concavely depressed sides, closely resembling that of a *Calliostoma* (a Trochid) in external appearance ... *E. hyphasma.*

— Shell not trochiform, turbinate, or depressedly turbinate, with basal surface more convex and rounded ... 2.

2. Shell rather thick, solid, with a well raised spire ; whorls of the spire inflated. Body whorl rounded, devoid of a keel ... ... *E. gardeneri.*

— Shell thinner, more depressed, with less strongly raised spire ; whorls of spire less markedly inflated, and body whorl generally with a keel round the periphery, though sometimes somewhat weak ... ... 3.

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3. Shell very thin, delicate and fragile, horny, having a glossy, oily lustre on the surface, and body whorl feebly or indistinctly angulated, and almost rounded along the periphery ... ... 4.

— Shell thicker, although sometimes rather thin, and surface as a rule much duller ; body whorl almost always sharply keeled, the keel being particularly strong and well raised towards the apertural end ... 5.

4. Shell with spire very low and depressed ; sculpture consisting of obliquely transpiral striae, decussating spiral lines being very feebly developed ; shell horny brown ... ... *E.* sp. nr. *sisparica.*

— Shell with the spire well elevated and convexly inflated whorls. Sculpture distinctly decussated. Shell much lighter in colour, pale greenish white ... ... *E. subdecussata.*

5. Shell with the whorls of the spire more or less rounded and inflated, the spire consequently presenting a convex, inflated contour, with the sutures strongly impressed ... 6.

— Shell depressedly turbinate, with the spire more or less conoidly depressed, the whorls of the spire having more or less flattened walls and the spire consequently presenting the form of a broad, flattened, almost straight-sided cone, with the sutures comparatively slightly impressed ... ... 8.

6. Sculpture on the surface of the shell with the obliquely transpiral striations more strongly developed, and rendered more strongly granular by the decussating spiral lines ; spire comparatively more strongly elevated in proportion to the diameter of the shell ; shell whiter, with the basal surface smoother and more polished ... ... *E. layardi.*

— Sculpture on the surface of the shell with the obliquely transpiral striations comparatively finer and less markedly granular ; spire less strongly elevated in proportion to the diameter of the shell ; shell more yellowish brown, with the basal surface duller and rather more strongly radiately striated ... ... 7.

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7. Sculpture consisting of very fine, close-set, obliquely transpiral striations which are not very uniform (some being stronger than the others) and crossed by fine spiral lines, resulting in a finely decussated effect ; spire rather low, less convex and flatter ... ... *E. indica.*

— Sculpture stronger, more uniform and file-like consisting of fairly strong, uniformly well developed, obliquely transpiral, plicate ridges rendered somewhat granular especially towards the periphery by decussating spiral lines ; spire comparatively higher and more markedly convex and rounded ... ... *E. indica* var. *shiplayi.*

8. Shell sublenticular in shape, the spire being very low and depressed, with the sutures very feebly impressed and the lower aspect of the shell convex ; whorls five and half in number, almost completely flattened above ; apex obtuse ... ... *E. acuducta.*

— Shell with more elevated, broadly conoid spire, with the sutures more strongly impressed. Whorls six or seven in number, apex acute, and sometimes prominently raised and papilla-like ... ... 9.

9. Whorls seven in number ; shell white, with a characteristic dark brown or chestnut periostracum. Spire somewhat higher in proportion to the width of its base ... ... *E. semidecussata.*

— Whorls six in number ; shell yellowish or straw-brown, with a tinge of purplish brown towards the apex ; spire somewhat flatter in proportion to the width of its base ... ... *E. travancorica.*

Euplecta layardi (Pfeiffer)

Plate XII, figs. 4*a* to 4*c*

Helix layardi, Pfeiffer, Proc. Zool. Soc. London, 1851, p. 253.
Euplecta layardi, Semper, Reise Phil., Wiss. Res., III, 1870, p. 14, pl. 3, figs. 3 and 4 (anatomy).
Helix layardi, Hanley & Theobald, Conch. Indica, 1876, p. 26, pl. 56, figs. 8 and 9.
Nanina (*Sitala*) *layardi*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 34.
Helix layardi, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 109, fig. 614.
Sitala layardi, Theobald, Cat. Shells Brit. India, 1876, p. 20.
Helix convexiuscula, Pfeiffer, Proc. Zool. Soc. London, 1855, p. 91.
Helix convexiuscula, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 35.
Helix convexiuscula, Hanley & Theobald, Conch. Indica, 1876, p. 52, pl. 128, figs. 5 and 6.
Euplecta layardi, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 55.

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The shell is narrowly umbilicated, thin, rather depressedly conoid and turbinated, the upper aspect being more or less broadly and convexly *Trochus*-shaped. The spire is broadly conoidal, with a slightly obtuse apex, and moderately impressed sutures. The whorls are six in number, somewhat convexly inflated above. The body whorl is distinctly keeled round the periphery, and rather strongly convex below. The aperture is oblique, broadly crescent-shaped, its outline being feebly angulated at the site of the keel on the body whorl. The peristome is thin, and the columellar margin reflected above, partly overhanging the umbilicus. The sculpture is very characteristic, consisting of regular, close-set, obliquely transpiral striae, decussated by fine, compressed spiral lines on the upper aspect, resulting in a more or less finely granulated appearance under the lens. The basal surface is much smoother and more glossy, being traversed only by fine radial striae. The shell is of a dull horny white colour, and slightly glossy, the lower surface being whiter and more polished.

Recorded localities : Ceylon, Kandy, Baticaloa, Hambantote.

Specimens in the collection : Although this species has so far been recorded only from Ceylon its range appears to extend to Southern India as well, as two dry-preserved shells from the Anamalais are contained in the Museum collection. The finely decussated sculpture on the upper surface of the shell is distinct in both the specimens, the transpiral ribbing being cut up into rows of fine nodules by the spiral lines. Measurements : Diameter : Major : 18 mm. ; minor : 16.5 mm. ; height : 12 mm. These are slightly larger than the type measurement cited by Blanford and Godwin-Austen (*loc. cit.*).

Euplecta subdecussata (Pfeiffer)

Plate XII, figs. 5*a* to 5*c*

Helix subdecussata, Pfeiffer, Proc. Zool. Soc. London, 1857, p. 107.
Helix subdecussata, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 28.
Helix subdecussata, Hanley & Theobald, Conch. Indica, 1876, p. 26, pl. 56, fig. 4.
Macrochlamys subdecussata, Theobald, Cat. Shells Brit. India, 1876, p. 18.
Nanina (Sitala) subdecussata, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 34.
Nilgiria subdecussata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Euplecta subdecussata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 55.

The shell is thin, narrowly umbilicated and turbinated, with a more or less broadly conoidal spire and obtuse apex. There are six whorls, slightly convex and inflated, and with the sutures fairly well impressed. The body whorl is bluntly and rather feebly keeled at the periphery, its basal surface being convex and more or less glossy. The sculpture consists of a somewhat irregular, fine, close-set, obliquely transpiaral plicate striation on the upper surface, decussated by fine, more or less obsolete impressed spiral lines. The basal surface is practically smooth and polished. The aperture is oblique and very broadly crescent-shaped. The peristome is simple, thin and straight-edged, with widely separated margins. The columellar margin is slightly reflected above, over the narrow umbilicus. The shell is thin, fragile, translucent and presents a glossy appearance, being somewhat greenish when fresh. Living specimens are found in moist and shady places in groves and gardens, and also in open fields with plenty of moist grass. They move about freely with their tentacles fully extended at night, under lamp-light.

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Recorded localities : Near Bombay ; Poona, Pooree, Tiruchirapalli and Madras. Living specimens of this species have been recorded by Ramanan (*loc. cit.*) from near tanks in Vepery, Royapuram, Perambur and Adyar in Madras.

Specimens in the collection : Three shells from Pamban, near Gulf of Manaar, and four from Madras, identified by Dr. Baini Prashad—all dry-preserved specimens, a few of them being broken and incomplete. This species has not been previously recorded from Pamban, and hence this is perhaps the first record of this species from that locality. The specimens are all faded and more or less uniformly white, or rather dirty brownish white. Measurements (of the largest among the Madras shells, which are larger than the Pamban specimens) : Diameter : Major : 14 mm. ; minor : 12 mm. ; height : 9 mm. These measurements are identical with those of the type cited by Blanford and Godwin-Austen (*loc. cit.*). No living specimens, however, have yet been collected from the Pamban area.

Euplecta semidecussata (Pfeiffer)

Plate XIII, figs. 1*a* and 1*b*

Helix semidecussata, Pfeiffer, Proc. Zool. Soc. London, 1851, p. 252.
Helix semidecussata, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 102, fig. 567.
Helix semidecussata, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 53.
Helix semidecussata, Hanley & Theobald, Conch. Indica, 1876, p. 27, pl. 58, figs. 1 and 2.
Rotula semidecussata, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina semidecussata, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 29.
Hemiplecta semidecussata, Clessin, Nomencl. Helic., 1881, p. 50.
Helix semidecussata, Collett, O., Journ. Roy. Asiatic Soc. Bengal (Ceyl. Br.) XV, 1897, p. 3.
Euplecta semidecussata, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1898, p. 101, pl. 97, figs. 2–2*d* (anatomy) ; pl. 98, fig. 5 (sculpture of shell).
Euplecta transpetata, subsp., Blanford, Proc., Malacol. Soc. London, IV, 1901, p. 249, pl. 25, fig. 9.
Euplecta semidecussata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 57.

Of all the species of *Euplecta* reported in this paper, the present one possesses the largest shell, attaining a diameter of over 30 mm., and a height of about 19 mm. The shell is large, narrowly umbilicated, and depressedly turbinated, with a broadly conoid spire, and a somewhat acute apex. The whorls are seven in number, regularly enlarging from above downwards, slightly convex above, and separated by rather feebly impressed sutures. The body whorl is more or less sharply angulated or keeled round the periphery and more strongly convex and inflated below than above. The sharpness of the keel on the body whorl is a variable feature : generally the keel is rather sharp and well defined at the proximal end, becoming gradually more blunt and obtuse towards the distal, i.e., apertural, end. The aperture is oblique, broadly crescent-shaped, with a simple, straight peristome, and with the columellar margin reflected above, partly occluding the umbilicus. The upper surface of the shell is finely obliquely and transpirally striated, these striae being decussated and interrupted by fine, impressed lines. The lower surface is finely and closely radiately striated throughout. The shell is white, covered by a brownish periostracum of varying shades, ranging from a pale yellowish brown to a dull reddish brown. Living specimens are frequently found among fallen leaves in forest and scrub jungle and form a favourite food for birds.

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Recorded localities : Ceylon ; Rambodde, Ceylon ; Southwestern Ceylon ; Ambagamuwa ; Travancore Hills, Southern India. The locality " Bombay " quoted by Theobald (*loc. cit.*) is obviously an error caused by the citing of the wrong figure in Hanley and Theobald's Conchologia Indica (1876).

Specimens in the collection : One dry-preserved shell from Watawala, Ceylon. The brownish periostracum is intact, except over a small portion on the basal surface where it has peeled away, exposing the white surface layer of the shell. The spire is in the form of a broad, straight-sided, flattened cone, the walls of the whorls being scarcely inflated and almost completely flattened. Measurements : Diameter : Major : 32 mm. ; minor : 29 mm. ; height : 18.5 mm. These measurements are only very slightly smaller than the type measurements cited by Blanford and Godwin-Austen (*loc. cit.*).

Euplecta travancorica (Benson)

Plate XIII, figs. 2*a* and 2*b*

Helix travancorica, Benson, Ann. & Mag. Nat. Hist., (3), XV, 1865, p. 13.
Helix travancorica, Pfeiffer, Mon. Helic. Viv., V, 1868, p. 130.
Helix travancorica, Hanley & Theobald, Conch. Indica, 1876, p. 24, pl. 50, fig. 6 ; pl. 149, fig. 7.
Hemiplecta travancorica, Theobald, Cat. Shells Brit. India, 1876, p. 22.
Nanina travancorica, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 29.
Euplecta agastyae, Beddome (subsp.), Blanford, Proc. Malacol. Soc. London, IV, 1901, p. 250, pl. 25, fig. 10.
Euplecta travancorica, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 58, fig. 32.

The shell is fairly large, more or less depressed and turbinated, being broadly conoid above and convexly inflated below ; it is thin, horny and narrowly perforate. The spire is low, and depressedly conoid, with almost straight, flattened sides and an acute apex. The whorls are six in number, regularly and gradually enlarging from above downwards, and separated by well impressed sutures. The body whorl is sharply keeled round the periphery, and markedly inflated on the basal aspect. The surface is sculptured with a fine, obliquely transpiral, close-set, costulate striation, decussated by fine impressed spiral lines which render the striae conspicuously granular, and more or less rasp-like in texture. The lower surface is comparatively smooth and glossy, but is still finely and closely radiately striated, decussated by fine impressed spiral striae, but these latter disappear towards the umbilicus. The aperture is oblique, broadly and circularly crescent-shaped, its outline being sharply angulated at the site of the keel on the body whorl. The peristome is thin, with its basal margin broadly curved, and the columellar margin slightly reflected above, partly covering the umbilicus. The shell is horny brownish, somewhat paler yellowish brown beneath. The apical whorls are purplish brown. *Euplecta praeemineus* is a distinct form from Southwestern Ceylon, characterized by a prominent papillary apex and concave sides for the spire, and is included in the list of synonyms for the present species by Blanford and Godwin-Austen (*loc. cit.*). As, however, the specimens in the Museum collection are from Southern India and belong to the typical form, the name of *E. praeemineus*, which must be treated as a distinct variety, has not been included in the synonymy above.

Recorded localities : Hills near Kottayam, Travancore, Southern India.

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Specimens in the collection : Two full-grown spirit-preserved specimens, one from the Netterikal Region of the Kalakkad Forest (altitude : 3,000 to 5,000 feet), Tinnevelly District, with the foot and the soft parts well extended, and the other from Palni Hills, Kodaikanal (altitude : 6,500 to 7,500 feet), Madurai District, with the soft parts intact, but badly contracted and for the most part retracted within the shell. Both the shells are thin, fulvous or pale horny brownish above and paler yellowish brown beneath. The apical whorls are somewhat darker, almost purplish brown. Measurements (of the larger shell from Kalakkad Forest) : Diameter : Major : 35 mm. ; minor : 31 mm. ; height : 16 mm. The diameters agree with the typical ones cited by Blanford and Godwin-Austen, but the height is considerably less in proportion to the diameter than in the type specimen cited. Further, in the other specimen examined, the height is proportionately smaller to an equal degree. The height of the spire in proportion to the diameter of the shell is apparently a rather variable feature in the present species.

Euplecta indica (Pfeiffer)

Plate XIII, figs. 3*a* and 3*b*

Helix indica, Pfeiffer, Symbolae, III, 1846, p. 66.
Helix indica, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 80.
Helix indica, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 83, fig. 448.
Helix indica, Blanford, Journ. Asiatic Soc. Bengal, 1866, 2, p. 39.
Helix indica, Hanley & Theobald, Conch. Indica, 1876, p. 26, pl. 55, fig. 10.
Rotula indica, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina indica, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 31.
Helix oblita, Pfeiffer, Proc. Zool. Soc. London, 1851, p. 263.
Helix oblita, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 54.
Euplecta indica, Blanford & Godiwn-Austen, Fauna Brit. India, Mollusca, 1908, p. 60.

The shell is rather narrowly umbilicated, depressedly turbinate, more or less lenticular, and shaped like a thick biconvex disc. The spire is broadly and depressedly conoid, with slightly convex sides and a somewhat obtuse apex. The whorls are five or six in number, regularly and gradually increasing in size from above downwards, slightly convex and inflated and separated by well impressed sutures. The body whorl is strongly keeled round the periphery, rather flattened above, and moderately inflated and rounded below. The upper surface is strongly sculptured with close-set, obliquely transpiral rib-like striae, decussated by impressed spiral lines, which render the ribs finely granular. The basal surface is much smoother and glossier, but finely and closely radiately striated throughout, with a few spiral impressed lines decussating the radial striae immediately below the peripheral keel. The aperture is oblique, slightly angulated at the site of the keel and broadly crescent-shaped. The peristome is fairly thick and blunt, with the columellar margin concavely arched and slightly reflected above. The shell is white, covered by a very thin, pale horny brown or yellowish brown periostracum throughout. The shell varies considerably in size and sculpture and Blanford and Godwin-Austen (*loc. cit.*) regard *Euplecta shiplayi* and *E. malabarica* as varieties of the typical form. *E. indica* is reported to be a common species on the Nilgiris and in certain localities in Malabar. The shell attains a fairly large size in the Nilgiris and Pulney Hills.

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Recorded localities : Nilgiris, Anamalais, Pulney Hills, the Wynaad and Western Mysore up to Kadur District ; South Canara, Lower Malabar, Beypore, Travancore ; Ceylon, North Mahols Atoll, Maldives. Blanford and Godwin-Austen (*loc. cit.*) have designated the form found in Beypore, South Malabar and Maldives as *E. malabarica*, which they consider as a variety of *E. indica*.

Specimens in the collection : DRY-PRESERVED SPECIMENS : Five shells from Pulney Hills, one from Trichur, Cochin State, and one smaller and thinner shell (probably young) from Horsleykonda, Chittoor District, identified by Dr. Baini Prashad. The specimen from Horsleykonda is labelled as *E. indica* var., the shell being smaller, thinner and more translucent than the others : it may be a half-grown specimen of the typical form. The shells from Pulney Hills are the largest.

SPIRIT-PRESERVED SPECIMENS : Several spirit-preserved specimens, with their soft parts intact, as detailed below are also contained in the collection : (i) Two, with whitish brown shells from Dhoni Forest, South Malabar (altitude : 1,000 to 4,000 feet) ; (ii) four specimens with brownish shells and with the foot well extended, from Horsleykonda, Chittoor District (altitude : 3,000 to 4,000 feet) ; (iii) Two specimens with rather dark brownish shells from Kambakkam Hill, Chingleput District ; (iv) Two specimens with pale yellowish or straw-brown shell from Tiruvannamalai Hill (altitude : 2,000 feet) South Arcot District. These two shells and one of the specimens from Horsleykonda have been indicated as probably belonging to a variety of *E. indica*, by Dr. Baini Prashad to whom the specimens were sent for identification. Measurements (of an average shell from Pulney Hills) : Diameter : Major : 25 mm. ; minor : 22 mm. ; height : 14 mm. These are larger than the type measurements, but specimens from the Nilgiris are said to attain a still larger size.

Euplecta indica (Pfeiffer) var. **shiplayi** (Pfeiffer)

Plate XIII, figs. 4*a* to 4*c*

Helix shiplayi, Pfeiffer, Proc. Zool. Soc. London, 1856, p. 327.
Helix shiplayi, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 38.
Helix shiplayi, Hanley & Theobald, Conch. Indica, 1876, p. 53, pl. 131, figs. 7 and 10.
Rotula shiplayi, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina shiplayi, Blanford, W., Journ. Asiatic Soc. Bengal, 1866, p. 39.
Nanina shiplayi, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 31.
Euplecta shiplayi ?, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1898, p. 102.
Euplecta shiplayi, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, pp. 60 and 61.

The earlier authors regarded this as a distinct species, but Blanford and Godwin-Austen (*loc. cit.*) regard it as a form of *E. indica*, to which it is closely allied, and the examination of specimens in the Museum collection has confirmed the view that it is a distinct variety of *E. indica*, and not a separate species, and hence it is treated as such in the present report.

The shell closely resembles that of the typical form, *E. indica*, but differs from it in being smaller, with a comparatively higher and more convex spire, and with a stronger, and more uniform, file-like sculpture. The sculpture of the upper surface of the shell consists of fairly strong, close-set, obliquely transpiral plicate ridges, rendered more or less markedly granular

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by regular decussating spiral lines, which are strongest towards the periphery. The body whorl is sharply keeled round the periphery, and convex and inflated on the basal aspect. The lower surface is comparatively smooth, and only very finely radiately striated. The aperture is oblique, broadly crescent-shaped, angulated at the site of the keel, and with the columellar margin partly reflected over the umbilicus. The shell is pale horny brown, whiter below. The animal of this variety also closely resembles that of the typical form, *E. indica* s. str. Living specimens of this variety have been recorded by Godwin-Austen (*loc. cit.*) as inhabiting the eastern base of both the Anamalais and the Nilgiris and the foot of the Coonoor Ghat.

Recorded localities : Coonoor Ghat, Pulney Hills, Anamalais, Nilgiris, Kadur District, Mysore, and South Canara.

Specimens in the collection : Two dry-preserved shells, originally labelled " *Nanina shiplayi* (Pfeiffer) " from Mudgiri, Mysore. They are typical, with the characteristic file-like sculpture. Measurements : Diameter : Major : 21 mm. ; minor : 19 mm. ; height : 12 mm.

Euplecta gardeneri (Pfeiffer)

Plate XIII, figs. 5*a* and 5*b*

Helix gardeneri, Pfeiffer, in Martini-Chemnitz, Conch. Cab., ed. 2, 1846, *Helix*, no. 703, pl. 112, figs. 12 and 13.
Helix gardeneri, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 47.
Helix gardeneri, Pfeiffer, Proc. Zool. Soc. London, 1847, p. 229.
Helix gardeneri, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 83, fig. 446.
Helix gardeneri, Hanley & Theobald, Conch. Indica, 1876, p. 36, pl. 84, fig. 7.
Rotula gardeneri, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina gardeneri, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 31.
Ariophanta gardeneri, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 40.
Euplecta gardeneri, Blanford & Godwin-Austen, ibid., p. 64.
Euplecta gardeneri, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1910, p. 299.

This species was at first assigned to the genus *Ariophanta* (Section *Cryptozona*) by Blanford & Godwin-Austen (*loc. cit.*, p. 40), but they later transferred it to its correct position in the genus *Euplecta* (Blanford & Godwin-Austen, *loc. cit.*, p. 64), after dissection and study of the soft parts of the animal. The shell of this species is more like that of a typical *Ariophanta* than in any of the other species of *Euplecta* reported in this paper. The shell is fairly thick, solid, narrowly umbilicated, turbinate, with a rather strongly raised, conoid spire terminating in an acute apex, and with well impressed sutures. The whorls are about six to seven in number, somewhat convex and closely wound. The body whorl is rounded at the periphery and devoid of a keel—a feature which readily distinguishes this species from most of the other preceding species of *Euplecta*. The surface of the shell is closely and obliquely transpirally striated, these striae being decussated by spiral lines, at rather wide intervals, which are sometimes obsolete. The body whorl is comparatively smooth, the striae being weaker and finer, especially on the basal surface. The aperture is oblique, broadly rounded and semi-lunate in shape. The peristome is fairly thick and obtuse, its basal margin being thicker. The columellar margin is reflected above, almost completely covering the umbilicus. The shell varies in colour from yellowish brown to dark chestnut with a characteristic pale spiral band on the periphery of the body whorl. Living specimens have

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been found beneath fallen leaves in forests at Uva, Ceylon. The animal has been well described by Godwin-Austen (*loc. cit.*).

Recorded localities : In forest, Uva, 5,000 feet elevation, Ceylon ; hills of South Western Ceylon, about 4,000 feet elevation, in forest, Newara Eliya, Ceylon.

Specimens in the collection : A single dry-preserved shell from Newara Eliya, Ceylon, deep yellowish brown over the body whorl, with a white spiral band at the periphery, darker brown towards the apex. Measurements : Diameter : Major : 22 mm. ; minor : 20 mm. ; height : 16 mm.

Euplecta acuducta (Benson)

Plate XIII, fig. 6

Helix acuducta, Benson, Ann. & Mag. Nat. Hist., (2) V, 1850, p. 214.
Helix acuducta, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 78 ; IV, 1859 p. 67.
Helix acuducta, Hanley & Theobald, Conch. Indica, 1876, p. 23, pl. 50, fig. 5.
Helix acuducta, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 124, fig. 739.
Nanina koondaensis, Blanford, Journ. Asiatic Soc. Bengal, 1870, p. 16, pl. 3, fig. 12.
Helix koondaensis, Hanley & Theobald, Conch. Indica, 1876, p. 26, pl. 56, figs. 5 and 6.
Helix (Nanina) koondaensis, Pfeiffer, Mon. Helic. Viv., VII, 1876, p. 225.
Nanina koondaensis, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 29.
Nanina subkoondaensis, Godwin-Austen, Proc. Malacol. Soc. London, II, 1897, p. 175.
Euplecta acuducta, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 67, fig. 36.

The shell is somewhat small, thin, perforate and much more strongly depressed than in the preceding species. The spire is very low and broadly conoidal, the sutures being very slightly impressed. The whorls are five or six in number, more or less flattened above, and regularly and gradually increasing in size from above downwards. The body whorl is sharply keeled round the periphery, somewhat compressed immediately below the keel, and more or less inflated below. The surface is finely and closely transpirally striated above, decussated by close-set, impressed spiral lines ; the lower surface is also similarly sculptured, but comparatively smooth, with finer and more close-set striae. The aperture is oblique, and angularly crescent-shaped. The peristome is slightly blunt and thick, white inside, with the columellar margin arched, and slightly reflected above. The shell is rather variable with regard to the height of the spire, sharpness of the keel and the sculpture. This species is closely allied to *E. indica* and to *E. travancorica*, but shells of *E. acuducta*, may as a rule be readily distinguished from those of either of these two species by the height of the spire being much smaller than the height of the body whorl below the keel. Some shells are subcostulately striated. The shell is pale fulvous horny in colour.

Recorded localities : Nilgiris, Sispara Ghat, Kundah Hills, Tinnevelly, Trivandrum, Kadur District, Mysore ; Botanical Gardens, Calcutta ; Ceylon.

Specimens in the collection : A single, rather immature spirit-preserved shell, with the soft parts intact, from Horsleykonda, Chittoor District (altitude : about 3,000 to 4,100 feet), identified by Dr. Baini Prashad. The shell is dull brownish white, thin, rather fragile, and partly broken. Measurements : Diameter : Major : 11 mm. ; minor : 10 mm. ; height : 6 mm. These measurements are only about half those of the typical adult measurements cited by Blanford and Godwin-Austen. The specimen is apparently a very young shell.

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Euplecta hyphasma (Pfeiffer)

Plate XIV, figs. 1*a* and 1*b*

Helix hyphasma, Pfeiffer, Proc. Zool. Soc. London, 1853, p. 124.
Helix hyphasma, Pfeiffer, Mon. Helic. Viv., IV, 1847, p. 40.
Helix hyphasma, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 187, fig. 1297.
Helix hyphasma, Hanley & Theobald, Conch. Indica, 1876, p. 25, pl. 54, fig. 3.
Sitala hyphasma, Theobald, Cat. Shells, Brit. India, 1876, p. 20.
Nanina (*Sitala*) *hyphasma*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 34.
Euplecta hyphasma, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1907, p. 186, pl. 114, figs. 1 and 1*a* (genitalia).
Euplecta hyphasma, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 69.

The shell is readily distinguished from those of all other species of *Euplecta* reported in this paper by its conical, trochiform shape. The shell is more or less in the form of a straight-sided cone and strongly recalls that of *Calliostoma tranquebarica*—a marine Trochid shell common on the Madras Coast—in external appearance. It is minutely umbilicated, thin and trochiform, the sides of the cone being slightly concavely depressed. The spire is conical, with straight sides, an acute apex and well impressed sutures. The whorls are six to seven in number, concavely flattened, the body whorl being sharply keeled at the periphery, the part below the keel being rather convex, with a smooth and glossy surface. The surface of the shell above the keel is minutely decussately sculptured with fine, oblique, transpiral ribs and impressed spiral lines, resulting in the ribs being finely granulated, but this granulation may often be obsolete. The aperture is oblique, more or less rhombus-shaped, and angular with a thin peristome. The columellar margin is arched below and reflected above, partly covering the umbilicus. The shell is thin, pale horny brown or brownish white, with a dull translucent gloss on the surface.

Recorded localities : Ceylon ; Kandy, Ceylon ; South-Western Ceylon ; Saffragam, Ambagamua, Ceylon.

Specimens in the collection : Two specimens, one dry-preserved shell from Kalakkad Forest, and one spirit-preserved specimen with the soft parts intact from the Netterikal Region, Kalakkad Forest (altitude : 3,000—5,000 feet), Tinnevelly District, South India, this being the first record of this species from Southern India, as it has been so far recorded only from Ceylon. The specimen is brownish white, sharply conical, with somewhat concavely depressed sides and with the peristome rather broken. Measurements : Diameter : Major : 15 mm. ; minor : 13·5 mm. ; height : 10·5 mm. These measurements are identical with those of the type specimen cited by Godwin-Austen (*loc. cit.*).

Euplecta sp. near **sisparica** (Blanford)

Plate XIV, figs. 2*a* and 2*b*

Nanina (*Hemiplecta*) ? *sisparica*, Blanford, Journ. Asiatic Soc. Bengal, 1866, 2, p. 34.
Helix sisparica, Pfeiffer, Mon. Helic, Viv., V, 1868, p. 122.
Helix sisparica, Hanley & Theobald, Conchologia Indica, 1876, p. 46, pl. 112, figs. 4, 5 and 6.
Hemiplecta sisparica, Theobald, Cat. Shells Brit. India, 1876, p. 22.
Ariophanta sisparica, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 37.

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A single dry-preserved shell collected from Palni Hills, in the Museum collection, has been identified by Dr. Baini Prashad as *Euplecta* (*Euplecta*) sp. prox. *sisparica* Blanford. The shell is very thin, delicate, translucent, narrowly umbilicated and depressed. The spire is very low, flattened and only very slightly convex. The whorls are six in number, rather flattened above. The body whorl is bluntly and rather indistinctly angulated at the periphery and rounded and convexly inflated below. The umbilicus is narrow, and the aperture oblique, broadly crescent-shaped, with a thin peristome, and with its columellar margin slightly reflected above. The surface of the shell is traversed by fine and close-set obliquely transpiral striae. The shell is translucent whitish, covered by a thin, horny brown or rather straw-brown periostracum which displays a peculiar oily gloss. The lower surface is comparatively smooth and more polished.

Recorded localities : The species *E. sisparica* has been recorded only from Sispara Ghat, Nilgiris, at an elevation of about 6,000 feet.

Specimens in the collection : The present specimen in the Museum collection, which has been provisionally identified as species near *sisparica* is from Palni Hills and is much smaller than the typical adult shell of *E. sisparica*. Further, there are six whorls in the present specimen whereas *E. sisparica* has only four and half whorls. The specimen is probably a young shell of a closely allied species, but further material is needed before this can be determined with certainty. Measurements : Diameter : Major : 18 mm. ; minor : 15 mm. ; height : 9 mm. ; aperture : width : 9 mm. ; height : 7 mm. These measurements are only about half of those of the type specimen of *E. sisparica* cited by Blanford and Godwin-Austen (*loc. cit.*).

Genus **Hemiplecta** Albers, 1850

The shell is large and thick, umbilicated, more or less inflated above, usually wrinkled, subterminate or depressed, rather solid, with the whorls regularly increasing in size from above downwards, and inflated, the body whorl being rounded or somewhat angular. The aperture is oblique and lunate, and the peristome obtuse, arched and sometimes more or less thickened.

Hemiplecta basileus (Benson)

Plate XIV, figs. 3*a* and 3*b*

Helix basileus, Benson, Ann. & Mag. Nat. Hist., (3), VII, 1861, p. 81, XIII, 1864.
Helix titanica, Pfeiffer, Proc. Zool. Soc. London, 1862, p. 117, pl. 12, fig. 3.
Nanina basileus, Blanford, Journ. Asiatic Soc. Bengal, 1866, 2, p. 39.
Helix basileus, Pfeiffer, Mon. Helic. Viv., V, 1868, p. 120 ; VII, 1876, p. 124.
Helix basileus, Hanley & Theobald, Conch. Indica, 1876, p. 13, pl. 25, fig. 7.
Hemiplecta basileus, Theobald, Cat. Shells, Brit. India, 1876, p. 22.
Nanina (*Hemiplecta*) *basileus*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 47.
Nilgiria basileus, Godwin-Austen, Proc. Malacol. Soc. London, V, 1902, p. 248, p. 6 (animal and anatomy).
Ariophanta basileus, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 41.
Ariophanta basileus, Hornell, Common Molluscs of South India, Mad. Fish. Bulletin, XIV, 1921, p. 148.

This is the largest of Indian land snails, popularly known as the Imperial Snail. The shell is very large, growing to well over two and half inches in diameter. Living specimens are abundant in the Cochin teak forests where they are occasionally eaten by the native tribes. They

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are also found in the Anamalai and Nelliampathy Hills. The shell is thick, narrowly umbilicated, broadly and conoidally depressed. The whorls are five and half in number, with almost flattened walls above. The body whorl is distinctly angulated at the periphery, convex below, and not inclined downwards towards the apertural end. The spire is rather low, convex and broadly depressedly conoid with an obtuse apex and slightly impressed sutures. The surface is obliquely transpirally decussated by a few faint, widely set, impressed spiral lines and traversed here and there by irregular, shallow, oblique grooves (which may often be absent). The aperture is oblique, and broadly ovate, with a thin, straight-edged peristome, the columellar margin of which is expanded and slightly reflected over the umbilicus. The shell has a rather coarse-looking surface and covered, when fresh, by a brownish yellow, horny periostracum. The shell is whitish, pink towards the apex and traversed, on the body whorl, by a broad, purplish brown, chestnut or blackish band round the periphery (from the angulation downwards). The band becomes paler below and gradually fades out into the white of the centre of the basal surface.

Recorded localities : Cochin Teak forests ; Anamalai Teak forest, 2,000 to 3,000 feet above sea level ; Trichur, Anamalais and Nelliampathy Hills.

Specimens in the collection : One spirit-preserved specimen with the soft parts intact, from Cochin forest and three dry-preserved empty shells of which one is from Anamalais, one from Nelliampathy Hills and the third from Cochin Teak forest. The spirit-preserved specimen and the dry-preserved shells from Cochin Teak forest and Nelliampathy Hills have the brownish yellow periostracum on the surface fairly intact. All the shells are of about the same size. Mesurements (of the spirit-preserved specimen) : Diameter : Major : 72 mm. ; minor : 62 mm. ; height : 39 mm. ; aperture : width : 38 mm. ; height : 31 mm. These measurements are almost identical with those of the typical specimen cited by Blanford and Godwin-Austen (*loc. cit.*), but the height of the aperture quoted by them (16 mm.) appears to be incorrect, as the median height of the aperture is over 30 mm. in all the shells examined.

Hemiplecta beddomii Blanford

Plate XIV, figs. 4*a* and 4*b*

Hemiplecta beddomii, Blanford, Ann. & Mag. Nat. Hist., (4), XIV, 1874, p. 406.
Helix beddomei, Hanley & Theobald, Conch. Indica, 1876, p. 65, pl. 159, fig. 10.
Hemiplecta beddomei, Theobald, Cat. Shells Brit. India, 1876, p. 22.
Nanina (*Hemiplecta*) *beddomei*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 47.
Ariophanta beddomii, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 42.

This species is closely allied to the preceding one, and Blanford and Godwin-Austen have even suggested that this may be a variety of *H. basileus*. The shell is smaller, thinner and more markedly depressed than in that species. The spire is low and depressedly convex. The body whorl is feebly angulated round the periphery. The sculpture is more or less the same as in the preceding species. The aperture is oblique and widely D-shaped with a simple peristome, the columellar margin of which is thickened and reflected. The shell is brownish with a dark brown or chestnut broad band on the body whorl from the periphery downwards, becoming paler below and bordered above at the periphery by a narrow pale spiral band. The latter character is

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seen in the specimen examined, but further specimens have to be examined before it can be regarded as of specific value.

Recorded localities : Travancore, and Pulney Hills ; Trivandrum.

Specimens in the collection : One dry-preserved, empty shell lent from the collections of the Zoology Department of the Madras Christian College. Its locality is not known. The shell is more or less chestnut brown in colour, with the broad band on the body whorl of a darker shade. It has only been tentatively referred to the present species. Measurements : Diameter : Major : 51 mm. ; minor : 42 mm. ; height : 25 mm. ; aperture : width : 26 mm. ; height : 21 mm. Except for the colouration, the shell agrees closely with the typical description and measurements cited for *Ariophanta beddomii* by Blanford & Godwin-Austen (*loc. cit.*), but as the shell is heavily varnished, it is possible that the colour might have been much lighter in the natural state.

Genus **Cryptozona** Mörch, 1872

The shell is dextral, umbilicated, more or less inflated, often ornamented with coloured spiral bands and obliquely striated. The aperture is oblique, more or less wide, and the peristome sharp or feebly thickened.

Formerly, the species now included in the genus *Cryptozona* were described as species of *Ariophanta*, but according to the present classification the genus *Ariophanta* strictly includes only species having sinistral shells, and species possessing *Ariophanta*-like dextral shells have been separated into the genus *Cryptozona*. Blanford and Godwin-Austen, however, while recognizing this distinction, still use the generic name *Ariophanta* for the dextral species also, although they have placed them under a separate group designated variously as *Cryptozona*, *Xestina* and *Nilgiria*. The two latter names are included by Thiele, rather as sub-sections of the genus *Cryptozona* than as having separate generic status, and as we have followed Thiele's classification in this paper, *Xestina* and *Nilgiria* have been treated as sub-genera under *Cryptozona* in the present report. The genus *Cryptozona* and its sub-sections include the majority of our common dextral-shelled land and garden snails which frequent moist and shady places in gardens, groves and lawns and are seen mostly in the wet season. Most of them aestivate during the hot weather, burying themselves underground or hiding in crevices until the rains return when they begin to be active.

As the genus *Cryptozona* (and the sections included in it such as *Xestina* and *Nilgiria*) include some of the most common species of land snails and as these species are also represented in the Museum collection, it has been considered desirable to draw up the following key to the species of *Cryptozona* represented in the Museum collection, with the help of which at least the more common forms may be distinguished on the basis of their shell characters :—

1. Shell strongly and globosely inflated, the height being normally very nearly equal to the minimum diameter... *C.* (*Nilgiria*) *semirugata.*

— Shell more depressed and broader in proportion to the height ; less strongly globose, the height being generally about half or two-thirds the diameter of the shell... 2.

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2. Shell uniformly coloured, without coloured spiral bands 3.

— Shell spirally banded with coloured bands ... ... 4.

3. Shell rather large, more or less finely decussately striated ... ... *C.* (*Xestina*) *belangeri.*

— Shell smaller, but thicker and more coarsely sculptured with rather thick-set and obliquely transpiral, ridge-like striae ... ... *C.* (*Xestina*) *albata.*

4. Surface of shell sculptured with transpiral striae only, not decussated ; shell with a broad white or whitish spiral band from the periphery of the body whorl downwards ... ... *C.* (*Nilgiria*) *maderaspatana.*

— Shell with a finely decussated sculpture and ornamented with narrower and more than one brightly coloured spiral bands ... ... 5.

5. Shell rather thick and solid, ornamented with reddish brown spiral bands just above the periphery on the body whorl and immediately above the suture in each whorl of the spire, the upper edge of these spiral bands being indistinct and merging with the paler brown ground colour of the shell ... ... *C.* (*Cryptozona*) *ligulata.*

— Shell thin, pale horny, encircled normally by two rufous spiral lines (one or both may be occasionally missing) with a whitish spiral band between them ... ... *C.* (*Xestina*) *bistrialis.*

Cryptozona ligulata (Férussac)

Plate XV, figs. 1*a* to 1*c*

Helix ligulata, Férussac, Hist. Nat., 1819–21, pl. 31, fig. 2.
Helix ligulata, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 71.
Helix ligulata, Reeve, Conch. Icon., VII, 1852, Helix, pl. 76, fig. 395.
Cryptozona turbinata, Mörch, Journ. Conch., XX, 1872, p. 335.
Helix turbinata, Pfeiffer, Mon. Helic. Viv., VII, 1876, p. 90.
Helix ligulata, Pfeiffer, ibid., p. 122.
Helix ligulata, Hanley & Theobald, Conch. Indica, 1876, p. 14, pl. 28, fig. 9.
Hemiplecta ligulata, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina (*Xesta* ?) *ligulata*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 50.
Helix ligulata, Godwin-Austen, Journ. Asiatic Soc. Bengal, XLIX, 1880, p. 158, pl. ii, fig. 3 (animal).
Nilgiria ligulata, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1899, p. 123, pl. 98, figs. 1–1*d* (animal, genitalia and sculpture).
Nilgiria ligulata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Ariophanta ligulata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 38.
Ariophanta (*Nilghiria*) *ligulata*, Godwin-Austen, Rec. Ind. Mus., XVI, 1919, p. 201.
Ariophanta ligulata, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 148.

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This species, with the shell bearing a single spiral band, and *C.* (*Xestina*) *bistrialis*, with its characteristic double spiral band on the body whorl of the shell, are the two most common species of land snails found in and around Madras gardens in the wet season. The shell is very narrowly umbilicated, and more or less depressedly globose and inflated. The whorls are six to seven in number, gradually and regularly increasing in size from above downwards. The body whorl is convex below, and very feebly and indistinctly angulated (or nearly evenly rounded) at the periphery. But some specimens show the angulation very clearly particularly towards the columellar side. The spire is broadly and rather depressedly conoid, the whorls being slightly convex and separated by well impressed sutures. The surface is sculptured with close-set, obliquely transpiral, somewhat flexuous striae, decussated by faintly impressed and rather widely separated spiral lines. The aperture is oblique and somewhat broadly D-shaped with the lower margin rather straight, and wider below than above. The peristome is simple and thin, but slightly thickened and reflected at the base and over the umbilicus. The shell is whitish, characteristically ornamented with a single, thick, dark brownish spiral band at the periphery of the body whorl, and just above each suture, the inner border of these bands being ill-defined and merging with the ground colour of the shell. The relative width of the spiral bands varies considerably in different shells. The basal surface of the shell is uniformly white, smooth, and bears a dull gloss. The animal and its soft parts are well described by Godwin-Austen (*loc. cit.*). The animal has a truncated tail, with a very large, almost rounded gland. There is considerable variation in the height of the spire, and Reeve's figure (*loc. cit.*) represents a form with rather a high spire, and is not very typical.

Recorded localities: Eastern part of Peninsular India ; Bundelkand, Chaibassa, Patna, Bhagalpur, Manbhum, Cuttack, Orissa ; Trivellore, Madras, Madras State and Bengal.

Specimens in the collection : Three dry-preserved shells and eighteen spirit-preserved specimens with their soft parts intact, all from Madras, and twenty-four empty dry-preserved shells collected by me recently from a Casaurina Thope at Tada, in Nellore District ; these latter had probably been thron up by birds after they had eaten the fleshy contents, as these thopes abound in omnivorous birds such as Mynas and Drongoes. Many of the spirit specimens are preserved with the foot well extended. The soft parts are dark fleshy brown in spirit. Measurements (of the average, full-grown shell) : Diameter : Major : 31·5 mm. ; minor : 28 mm. ; height : 22 mm. ; aperture : width : 16 mm. ; height : 14 mm. The Madras specimens in the Museum collection are considerably larger than the typical measurements quoted by Blanford and Godwin-Austen (*loc. cit.*). Ramanan (*loc. cit.*) mentions two distinct varieties of *C. ligulata* as occurring within Madras City limits—one with a large, many-whorled shell, having the spire somewhat high and the other smaller with a sort of angulation on the body whorl. The majority of the specimens in the Museum collection seem referrable to the former variety, but as there are gradations between the two forms especially as regards the height of the spire, they cannot be regarded as well defined varieties.

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Sub-genus **Xestina** Pfeffer, 1878

Cryptozona (Xestina) belangeri (Deshayes)

Plate XV, figs. 2*a* and 2*b*

Helix belangeri, Deshayes, in Belanger, Voy. Zool., 1834, p. 43, pl. 1, figs. 1–3.
Helix belangeri, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 69.
Helix belangeri, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 206, fig. 1457.
Helix belangeri, Hanley & Theobald, Conch. Indica, 1876, p. 14, pl. 29, fig. 6.
Helix bombayana, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 41.
Helix bombayana, Hanley & Theobald, Conch. Indica, 1876, p. 14, pl. 29, fig. 5.
Hemiplecta belangeri, Theobald, Cat. Shells Brit. India, 1876, p, 21.
Hemiplecta bombayana, Theobald, ibid., p. 21.
Hemiplecta vitellina, Theobald, ibid., p. 22.
Helix vitellina, Hanley & Theobald, Conch. Indica, 1876, p. 27, pl. 59, figs. 1 and 2.
Helix vitellina, Pfeiffer, Proc. Zool. Soc. London, 1848, p. 109.
Helix vitellina, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 72.
Nanina (*Xesta*?) *belangeri*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 51.
Nanina (*Xesta*?) *bombayana*, Nevill, ibid., p. 51.
Nanina (*Xesta*?) *vitellina*, Nevill, ibid., p. 51.
Nilgiria vitellina, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Xestina bombayana, Smith, E.A., Fauna & Geography of the Maldive & Laccadive Archipelagoes, 1902, p. 142.
Ariophanta belangeri, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 36.

The shell is moderately large, somewhat depressedly globose, inflated and openly umbilicated. The spire is rather low and depressed, but distinctly convex with slightly inflated whorls and the sutures are well impressed. The whorls are six in number, rather convex, the body whorl being large and inflated, but comparatively smaller and more depressed than in *Cryptozona* (*Nilgiria*) *semirugata*, and not appreciably inclined downwards towards the apertural end as in that species. The body whorl is almost evenly rounded at the periphery. The surface of the shell is obliquely transpirally striated above and smoother below, the striae being decussated by faint impressed spiral lines above (which are often absent altogether). The aperture is wide, almost as broad as high, and very broadly crescent-shaped, with a thin peristome which is slightly reflected towards the base and the columellar margin. The colour is variable, ranging from whitish or pale horny to a rufous or even purplish brown. There is also considerable variation in size among shells collected from different localities, and *C. vitellina* and *C. bombayana*, which have been quoted above as synonyms may be considered as smaller varieties of the typical form. Ramanan (*loc. cit.*) mentions that this species may be distinguished from other Madras species of the genus by its " extremely delicate, transparent and pale-coloured shell ", but this probably refers mostly to young and immature forms, as there are specimens in the Museum collection, the shells of which are quite thick, solid and opaque. There are no coloured spiral bands on the shell in this species.

Recorded localities : Pondicherry, Madura, South Arcot and Malabar ; Nilgiris, Pooree and Coonoor Pass ; Anamalai Hills, Pulney Hills, Madras, and generally all over the southernmost part of the peninsula and also in North Mahlor Atoll, Maldives, (introduced).

Specimens in the collection : Both dry shells and spirit-preserved specimens with their soft parts intact, most of them from localities from which the species has not so far been specifically recorded, are contained in the Museum collection.

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DRY SHELLS : Three specimens, all fairly large, out of which two with tawny brown shells, are from Kambakkam Hill, Chingleput District (altitude : 1,500—2,500 feet), and one thicker, more solid and more whitish shell is from Nagalapuram Hill, Chingleput District (altitude : 500—2,400 feet). In addition to these, there is one rather pale greenish brown shell lent from the Zoology Departmental collection of Madras Christian College, but the locality of this shell is not known. Measurements (of the large shell from Nagalapuram Hill): Diameter : Major : 46 mm. ; minor : 38 mm. ; height : 28 mm. ; aperture : diameter : 22 mm. ; height : 21·5 mm. These measurements are almost identical with those of the typical form from Madurai cited by Blanford and Godwin-Austen (*loc. cit.*).

SPIRIT-PRESERVED SPECIMENS : Four specimens with the foot well extended, authentically identified and labelled as *Xesta* (*Xestina*) *belangeri* by Dr. Baini Prashad, out of which two are from Pulney Hills, Kodaikanal (altitude : 6,500—7,500 feet), one is from Kalakkad Forest (Netterikal Region), Tinnevelly District (altitude : 3,000 to 5,000 feet) and the other is from Kambakkam Hill, Chingleput District (altitude : 200 to 800 feet). Of these the one from Kambakkam Hill is the largest and approximates the measurements of the dry shell cited above. In addition to these, there are three specimens from Kodaikanal in the gallery collection, with the soft parts well expanded.

Cryptozona (Xestina) albata (Blanford)

Plate XV, figs. 3*a* and 3*b*

Xestina albata, Blanford, Journ. Asiatic Soc. Bengal, 1880, pt. 2, p. 189, pl. 3, fig. 3.
Xestina albata, Blanford, Proc. Malacol. Soc. London, IV, 1901, p. 245.
Helix lucublanda, Ancey, Le Nat., III, 1886, p. 293.
Ariophanta albata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 37.

The shell of this species resembles that of the preceding one, to which it is closely allied, in many respects, but is smaller, thicker, more solid and more coarsely sculptured with somewhat irregular, obliquely transpiral, impressed, close-set grooves. These grooves occur in groups of varying number, the groups being separated by rather stronger and more deeply impressed broader grooves which are strongly marked above, towards the suture (on the body whorl), but become shallower and fainter towards the basal surface. There are no decussating spiral lines. The spire is more or less broadly and depressedly conoid, with the whorls slightly convex and with the sutures well impressed. The whorls are five to six in number and rather inflated, the body whorl being rounded at the periphery and definitely inclined downwards towards the aperture. The aperture is broadly rounded and lunate, with the columellar margin reflected above. The shell is white throughout, without coloured spiral bands, and is intermediate in shape between those of *C.* (*Xestina*) *belangeri* and *C.* (*Nilgiria*) *maderaspatana*, being broader in proportion to the height than the former, and less depressed than the latter.

Recorded localities : Papanassam, in the Hills west of Tinnevelly, Southern India.

Specimens in the collection : Two dry-preserved shells from Tinnevelly, uniformly whitish throughout. In these shells, the broad deeper grooves separating groups of the finer grooves become

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more numerous and more closely set towards the apertural end. The surface is slightly glossy in both the shells. Measurements (of the larger shell) : Diameter : Major : 30 mm. ; minor : 26 mm. ; height : 18.5 mm. ; aperture : width : 16 mm. ; height : 14.5 mm.

Cryptozona (Xestina) bistrialis (Beck)

Plate XV, figs. 4*a* and 4*b*

Nanina bistrialis, Beck, Ind. Moll., I, 1837, p. 2.
Helix bistrialis, Pfeiffer, in Chemnitz, Conch.-Cab., Ed. 2, 1846, *Helix*, No. 61, pl. 11, figs. 10 and 11.
Helix bistrialis, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 71 ; VII, 1876, p. 122.
Helix bistrialis, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 90, fig. 483.
Helix bistrialis, Hanley & Theobald, Conch. Indica, 1876, p. 14, pl. 29, fig. 1.
Hemiplecta bistrialis, Theobald, Cat. Shells Brit. India, 1876, p. 22.
Nanina (*Xesta* ?) *bistrialis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 51.
Nilgiria bistrialis, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1898, p. 89, pl. 80, fig. 4 (genitalia) ; pl. 82, fig. 5 (radula).
Nilgiria bistrialis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Ariophanta bistrialis, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 39.
Ariophanta bistrialis, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 148.

This species is readily distinguished from all other species of *Xestina* reported in this paper by its thin shell, with its characteristic double spiral band on the body whorl. Blanford and Godwin-Austen (*loc. cit.*) have included *Ariophanta ceylanica*, *A. taprobanensis* and *A. cyix*, also in the synonymy of the present species, but these are strictly varieties of the typical form from Ceylon and Matelle ; the usual South Indian form, *Cryptozona* (*Xestina*) *bistrialis* s. str. alone is represented in the Museum collection.

The shell is thin, rather fragile, fairly openly umbilicated, depressedly globose and inflated. The whorls are four to five in number, with almost flattened walls, rather rapidly enlarging from above downwards. The body whorl has an almost horizontally flattened upper surface, and is rounded at the periphery, convex below, and not inclined downwards towards the apertural end. The spire is low and depressed, only slightly convex. The surface is finely and closely obliquely transpirally striated, decussated with finely impressed spiral lines (which may often be obsolete), and smoother and more glossy below. The aperture is large, very broadly and obliquely ovate with a thin and sharp-edged peristome, the columellar margin of which is slightly reflected above over the umbilicus. The shell is pale horny brown, or brownish white the body whorl being encircled round the periphery by two reddish brown spiral lines (of which one or both may be occasionally absent), with a whitish spiral band between them. The upper of these reddish brown lines is continued close on the inside of the sutures on the other whorls. The reddish brown spiral lines are fairly close together towards the proximal end, but slightly diverge towards the apertural end. From an examination of the specimens in the Museum collection it is observed that there is some variation in the degree to which these spiral lines are approximated. This is one of the commonest species of Madras snails and is abundant in gardens during the wet season. Ramanan (*loc. cit.*) mentions that shells from the compound of the Theosophical Society, Adyar, Madras, have the edge of the peristome distinctly projecting. Unlike the preceding species, the animal in the present species has a fairly pointed tail.

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Recorded localities : Bangalore, Balarangam, Tiruchirapalli, Shevroys, Madras and Andhra States as far north as the Godavari ; Ceylon. Specimens from the Shevroy Hills are particularly large, measuring as much as 40 mm. in diameter, but the usual specimens from the plains are smaller.

Specimens in the collection : Both dry-preserved empty shells and spirit-preserved specimens with their soft parts intact and with their foot well extended are contained in the collection.

Dry shells : Three fairly large shells from Mr. Crichton's duplicate collection, the locality of which is uncertain, but is probably Madras ; four shells, two adult and two half-grown, with polished, translucent lower surfaces, from Madras ; and two large shells from the Shevroy Hills.

Spirit-preserved specimens : Fourteen specimens, most of them full grown and large, and others smaller and young shells—all from Madras. In addition to these, there are several eggs, and tiny, very young, just hatched shells. The eggs are small, yellowish, broadly spindle-shaped structures, with oblique, brownish groove-like folds. The average measurements of the eggs are : length : 6 mm. ; width : 4 mm.

Measurements of the adult shells : (*a*) Large dry-preserved shell from Shevroy Hills : Diameter : Major : 40 mm. ; minor : 34.5 mm. ; height : 23 mm. ; aperture : width : 20 mm.; height : 19 mm. ; (*b*) Average adult shell from Madras : Diameter : Major : 32 mm. ; minor : 28 mm. ; height : 17 mm. ; aperture : width : 17.5 mm. ; height : 15 mm. Even the Madras shells in the Museum collection are considerably larger than the type specimen, measurements of which are cited by Blanford and Godwin-Austen (*loc. cit.*).

Sub-genus **Nilgiria** Godwin-Austen, 1888

Cryptozona (**Nilgiria**) **semirugata** (Beck)

Plate XVI, figs. 1*a* and 1*b*

Galaxis semirugata, Beck, Index Moll., 1837, p. 42.
Helix semirugata, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 41.
Helix semirugata, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 75, fig. 391.
Helix semirugata, Hanley & Theobald, Conch. Indica, 1876, p. 27, pl. 59, fig. 4.
Hemiplecta semirugata, Theobald, Cat. Shells Brit. India, 1876, p. 22.
Nanina (*Xesta*) *semirugata*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 51.
Helix tranquebarica, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 41.
Helix tranquebarica, Reeve, Conch. Icon., VII, 1852, Helix, pl. 75, fig. 394.
Helix tranquebarica, Stoliczka, Journ. Royal Asiatic Soc. Bengal, XLI, 1872, 2, p. 212 (footnote).
Nilgiria tranquebarica, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1897, p. 78, pl. 81, figs. 3–3*d*.
Xesta tranquebarica, Semper, Reis. Philippinen, Land Moll., III, 1870, p. 65, pl. iii, fig. 26, pl. v, figs. 13–23 pl. vii, fig. 10.
Nilgiria semirugata, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 54.
Ariophanta semirugata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 35.

The shell of this species is readily distinguished from those of all other species of *Cryptozona* reported in this paper by its globose and elevated form, although there is considerable variation in shell form, especially with regard to the height of the spire. The shell is narrowly umbilicated, globose and inflated, sometimes appearing almost like that of a small *Pila* (apple snail). The

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whorls are five to six in number, separated by slightly impressed sutures. The body whorl is large and inflated and considerably higher in proportion to its width than in the other species, and generally downwardly inclined towards the aperture. The spire is rather variable in its height, being sometimes rather elevated and convexly conoid, and sometimes more or less depressed. The surface of the shell is sculptured with fine, obliquely transpiral striae, decussated with fine impressed spiral lines (sometimes obsolete), and rather smoother below. The aperture is large, broad and obliquely ovate, with a thin peristome, the columellar margin of which is reflected above, over the umbilicus, partly covering the latter. The colour of the shell is variable, ranging from whitish to a pale horny brown. There is considerable variation in the size of the shell as well as in its external form and thickness. Although *C. tranquebarica* is quoted above as synonymous with *C. semirugata*, the former has, perhaps, to be strictly regarded as a variety characterized by a thicker and more globose shell with coarser sculpture, while in the typical *semirugata* the shell is thinner and comparatively smoother. This species is common in open country in moist localities.

Recorded localities : Throughout the greater part of the Peninsula of India ; Cutch, Poona, Ahmednagar, Bengal and Deccan ; Tranquebar, Madras and Tiruchirapalli ; Northern Ceylon.

Specimens in the collection : A large number of specimens of varying sizes, from various localities from which the species has not been hitherto specifically recorded, are contained in the Museum collection.

Dry shells : The dry-preserved shells in the collection are from the following localities : (1) Madras : five (two large and three small) ; Coimbatore : two (large) ; Ramnad District : two (moderately large) ; Kakinada, East Godavari District : two (small, brownish). The largest shell is from Coimbatore.

Spirit-preserved specimens : Several large, well-preserved specimens in spirit, with their soft parts intact and with their foot well extended, from various localities, are represented in the Museum collection. The details of the number and localities of the specimens are as follows : Fourteen specimens from Madras, most of them with the spire rather strongly depressed ; three large shells from Bangalore (altitude : 3,000 feet), Mysore, of which one has the spire rather more markedly convex than the others ; one somewhat deep brownish shell from Attikan (altitude : 5,000 feet) Mysore, South India ; and two young shells with thin, rather horny and yellowish white translucent shells less than half the size of the adult from Vandalur, Chingleput District.

Measurements : As already mentioned, the size and form of the shell varies considerably in different localities. The measurements of the large, adult dry shell from Coimbatore, in which the spire is fairly well elevated and conical, are as follows : Diameter : Maximum : 42 mm. ; minimum : 36 mm. ; height : 36.5 mm. ; aperture : height : 26.5 mm. ; width : 21 mm. It will be observed that these are much larger than the maximum measurements quoted by Blanford and Godwin-Austen (*loc. cit.*). The spirit-preserved shells in the collection, from Bangalore, are also nearly as large as the above specimen, while shells from Madras are on the average smaller and approach more closely the typical measurements cited by Blanford and Godwin-Austen (*loc. cit.*).

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Cryptozona (Nilgiria) maderaspatana (Gray)

Plate XVI, figs. 2*a* and 2*b*

Helix maderaspatana, Gray, Proc. Zool. Soc. London, 1834, p. 67.
Helix maderaspatana, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 63 ; IV, 1859, p. 54 ; VII, 1876, p. 118.
Helix maderaspatana, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 75, p. 392.
Helix maderaspatana, Hanley & Theobald, Conch. Indica, 1876, p. 14, pl. 28, fig. 2.
Hemiplecta maderaspatana, Theobald, Cat. Shells Brit. India, 1876, p. 21.
Nanina (*Xesta* ?) *maderaspatana*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 51.
Ariophanta maderaspatana, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 45.

The shell is moderate-sized, fairly thin [but thicker than in *C.* (*Xestina*) *bistrialis*], somewhat depressedly globose, inflated and openly umbilicated. The whorls are five to six in number, convexly inflated and separated by well impressed sutures. The body whorl is rounded at the periphery and convex below. The spire is low, rather depressed, broadly conoid and convex, with a more or less obtuse apex. The surface is rather coarsely sculptured with fine, close-set, obliquely transpiral striae which become fainter below, the lower surface of the body whorl being smoother. There are no decussating spiral impressed lines or grooves. The aperture is oblique and broadly crescent-shaped, with a simple thin-edged peristome slightly thickened and expanded on the columellar margin and reflected rather broadly towards the umbilical end. The shell is dull brownish above, the brown generally merging into white in the uppermost parts of the whorls ; the colour on the body whorl changes abruptly into white at the periphery, where there is usually a white or whitish, more or less well marked narrow spiral band. But there is considerable variation in the colouration ; sometimes the shell is pale horny throughout and sometimes reddish brown, spotted with white.

Recorded localities : Hills of Mysore, Nilgiris, Kolamalais, Shevroy Hills, Chittycolam Hill, north of Tiruchirapalli (altitude : about 1,500 feet) ; Avalanche and Bangalore. The locality " Madras " mentioned by Hanley and Theobald (*loc. cit.*) seems doubtful.

Specimens in the collection : Two empty dry-preserved shells from Pulney Hills and several spirit-preserved specimens with their soft parts intact and most of them with their foot well extended, from various localities, as detailed below : Two from Tiruvannamalai, South Arcot District, (altitude : 2,000 feet) ; two from Kunnavaram, East Godavari District ; ten from Horsleykonda, Chittoor District, (altitude : 3,000 to 4,100 feet) ; one from Nagalapuram Hill, Chingleput District, (altitude : 500 to 2,400 feet) and four from Ootacamund, Nilgiris, (altitude : 6,700 to 8,000 feet). Measurements (of an average specimen) : Diameter : Major : 30 mm. ; minor : 25.5 mm. ; height : 18 mm. ; aperture : width : 14 mm. ; height : 13 mm. These measurements very nearly approximate to the typical measurements cited by Blanford and Godwin-Austen (*loc. cit.*). The shells in the collection vary in colour from dull brownish white to a fairly deep horny brown.

Genus **Ariophanta** Desmoulins, 1829

The shell is sinistral, narrowly umbilicated, rounded or depressed, obliquely striated. The body whorl is usually rounded, sometimes somewhat angular. The aperture is oblique and the

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peristome is reflected over the umbilicus. As already mentioned, only species with sinistral shells are now included in the genus *Ariophanta.*

The three species of *Ariophanta* represented in the Museum collection, *viz.*, *A. kadapaensis*, *A. cysis* and *A. thyreus* may be distinguished as follows :—

1. Shell globose, with fairly elevated spire, narrowly umbilicated and with white spiral bands on brownish ground colour ... ... *A. kadapaensis.*

— Shell rather depressed, with comparatively low and depressedly convex spire, more widely and openly umbilicated, without white spiral bands ... ... 2.

3. Whorls four and half in number, rapidly enlarging in size from above downwards ; sculpture consisting of obliquely transpiral striae only ; no coloured spiral band round the periphery ... ... *A. cysis.*

— Whorls five to six in number, enlarging more gradually ; sculpture decussated above ; with a dark reddish brown spiral band just below the periphery ... ... *A. thyreus.*

Ariophanta kadapaensis (Nevill)

Plate XVI, figs. 3*a* and 3*b*

Helix nicobarica, Chemnitz, Martini & Chemnitz, Syst. Conch. Cab., IX, 1795, p. 79, pl. 108, figs. 911 and 912.
Helix nicobarica, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 40 ; VII, 1876, p. 75.
Helix nicobarica, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 171, fig. 1157 (figure rather under-sized).
Helix nicobarica, Blanford, Journ. Asiatic Soc. Bengal, XXXVIII, 1869, p. 139.
Helix nicobarica, Hanley & Theobald, Conch. Indica, 1876, p. 24, pl. 52, fig. 1.
Ariophanta nicobarica, Theobald, Cat. Shells Brit. India, 1876, p. 23.
Nanina (*Ariophanta*) *kadapaensis*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 19.
Nanina (*Ariophanta*) *kadapaensis*, Godwin-Austen, Land & Freshwater Mollusca of India, I, 1898, p. 141.
Ariophanta kadapaensis, Blanford & Godwin-Austen, Fauna Brit, India, Mollusca, 1908, p. 30.

The shell is fairly large, globosely inflated, thick and solid, narrowly umbilicated and higher in proportion to the width than in the two succeeding species. The spire is fairly well elevated and broadly conoid and convex, with an obtuse apex and well impressed sutures. The whorls are five to six in number, somewhat convex, the body whorl being large, inflated, rounded at the periphery and convex below. The surface is sculptured with fairly strong close-set obliquely transpiral striae decussated with impressed spiral lines (which may, however, be sometimes obsolete). The aperture is very oblique, almost diagonally extending downwards at an angle with the axis of the shell, and broadly rounded and more or less D-shaped. The peristome is simple, slightly thickened on the columellar margin and reflected above, partly covering the umbilicus. The shell is dull chestnut-brown, with a broad, white spiral band round the periphery on the body whorl and similar but narrower spiral bands on the whorls of the spire near the sutures,

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rather indistinctly merging with the brown of the ground colour below, but sharply bordered by a narrow brown spiral band above, closely bordering the sutures. Below the white peripheral spiral band on the body whorl, the brown ground colour shows up again as a dark spiral band which, however, rapidly fades out below into a broad white area on the basal surface. A small area surrounding the umbilicus (periomphalus) and the parietal wall of the aperture are dark brown.

Recorded localities : Cudapah, Kurnool and Nallamalai Hills. Nevill (*loc. cit.*) states that the specific name " *nicobarica* " applied to this species by the earlier authors is a misnomer as it is not found in the Nicobar Islands.

Specimens in the collection : Four empty dry-preserved shells from the Nallamalai Hills. The characteristic spiral banding and the close, oblique striated sculpture are very well marked. All are fairly large and of about the same size. Measurements : Diameter : Major : 40 mm. ; minor : 35 mm. ; height : 28 mm. ; aperture : width : 22 mm. ; height : 20 mm. There is some variation in the relative height of the spire among the specimens examined.

Ariophanta thyreus (Benson)

Plate XVI, figs. 4*a* to 4*c*

Helix thyreus, Benson, Ann. & Mag. Nat. Hist., (2), 1852, p. 405.
Helix thyreus, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 251 ; VII, 1876, p. 454.
Helix thyreus, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 123, fig. 735.
Helix thyreus Hanley & Theobald, Conch. Indica, 1876, p. 13, pl. 27, fig. 6.
Ariophanta thyreus, *Theobald*, Cat. Shells Brit. India, 1876, p. 23.
Nanina (*Ariophanta*) *thyreus*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 19.
Ariophanta thyreus, Godwin-Austen, Journ. Asiatic Soc. Bengal, 1880, p. 152.
Ariophanta thyreus, Godwin-Austen, Land & Freshwater Mollusca of India, I, 1883, p. 140.
Ariophanta thyreus, Blanford, Proc. Malacol. Soc. London, IV, 1901, p. 244.
Ariophanta thyreus, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 34.

The shell is depressed and somewhat more openly and widely umbilicated than in the succeeding species. The whorls are five to six in number, increasing in size more gradually and regularly from above downwards than in *A. cysis*. The body whorl is distinctly angulated round the periphery, and convex and inflated beneath. The spire is low and depressed, slightly convex, with obtuse apex and slightly impressed sutures, except towards the apertural end where the suture is rather strongly impressed. The sculpture consists of fine, obliquely transpiral striae, distinctly decussated above with fine, impressed, spiral lines. The basal surface of the body whorl is smoother and more polished. The aperture is relatively much smaller than in *A. cysis*, and less strongly oblique, and broadly crescent-shaped. The peristome is obtuse and more or less thickened and slightly reflected especially over the basal and umbilical margins, but the umbilicus is almost completely uncovered. The shell is horny brown, usually with a darker reddish brown band below the angulation on the body whorl.

Recorded localities : Brahmageri (Coorg) ; Nilgiris ; Sispara, Nilgiris ; Balarangam Hills and Anamalais.

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Specimens in the collection : Two empty dry-preserved shells, moderate-sized, from the Nilgiris. One of these is slightly smaller and bears a pale, whitish spiral band at the peripheral angulation of the body whorl, just above the broad, rufous brown band. Measurements (of the larger shell) : Diameter : Major : 34 mm. ; minor : 29 mm. ; height : 16 mm. ; aperture ; width : 18.5 mm. ; height : 14.5 mm. These measurements are identical with those of the typical form cited by Godwin-Austen (*loc. cit.*).

Ariophanta thyreus var. **ryssolemma** (Albers)

Plate XVI, figs. 5*a* and 5*b*

Helix ryssolemma, Albers, Zeitschr. Mal., 1852, p. 186.
Helix ryssolemma, Pfeiffer, Mon, Helic. Viv., III, 1853, p. 634.
Helix ryssolemma, Pfeiffer, Nov. Conch., I, 1854, p. 37, pl. 10, figs. 13 and 14.
Ariophanta ryssolemma, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 34.

A single specimen from the Nilgiris in the Museum collection seems referable to the present variety. The shell is much larger than that of the typical form, measuring over 40 mm. in diameter, with a coarser sculpture. The suture separating the body whorl from the spire is deeply impressed.

Recorded localities : Sispara Ghat, Nilgiris.

Specimens in the collection : One large, empty, dry-preserved shell from the Nilgiris (probably from Sispara Ghat, but this is not mentioned in the label). It is yellowish brown, worn into a dull white over the greater part and with a coarse surface. Measurements : Diameter : Major : 44 mm. ; minor : 37 mm. ; height : 21 mm. ; aperture : width : 22 mm. ; height : 19 mm.

Ariophanta cysis (Benson)

Plate XVII, figs. 1*a* and 1*b*

Helix cysis, Benson, Ann. & Mag. Nat. Hist., (2), IX, 1852, p. 404.
Helix cystis, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 123, fig. 737.
Helix cysis, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 92 ; IV, 1859, p. 174 ; VII, 1876, p. 277.
Helix auris, Pfeiffer, Proc. Zool. Soc. London, 1854, p. 286.
Helix auris, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 173.
Helix cysis, Hanley & Theobald, Conch. Indica, 1876, p. 13 ; pl. 25, fig. 5.
Ariophanta cysis, Theobald, Cat. Shells Brit. India, 1876, p. 23.
Nanina (*Ariophanta*) *cysis*, Nevill, Hand List Moll. Ind. Mus., 1878, I, p. 19.
Ariophanta cysis, Godwin-Austen, Journ. Asiatic Soc. Bengal, 1880, p. 152.
Ariophanta cysis, Godwin-Austen, Land & Freshwater Mollusca of India, I, 1883, p. 139 ; II, 1898, pl. 82, fig. 7 (teeth of radula).
Ariophanta cysis, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 33.

The shell is somewhat thin, inflated, depressedly globose and openly umbilicated. The spire is rather low, but convex, with an obtuse apex and slightly impressed sutures. The whorls are four to five in number, rather rapidly increasing in size from above downwards, the body whorl being large, inflated, rather angularly rounded at the periphery and convexly swollen on the basal surface, and not appreciably inclined downwards towards the apertural end. The surface of the shell is slightly glossy, sculptured with very fine and close-set obliquely transpiral striae,

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and smoother below. The aperture is oblique, extending downwards at an angle to the axis of the shell, with a thin and straight-edged peristome, the columellar margin of which is slightly thickened and reflected, and only very slightly covers the umbilicus above. The inner terminations of the peristome are slightly approximated towards each other. The shell is pale yellowish brown or straw-brown in colour, with no trace of any spiral bands.

Recorded localities : Nilgiris, Anamalais. Other varieties are also known, *viz.*, var. *ampullarioides* from Nilgiris, and var. *dalyi*, from Mysore, but only the typical form is represented in the Museum collection.

Specimens in the collection : A single, large, dry, empty shell from the Nilgiris, bleached almost pure white throughout. Measurements : Diameter : Major : 44 mm. ; minor : 36 mm. ; height : 24.5 mm. ; aperture : width : 21 mm. ; height : 20 mm. Godwin-Austen (*loc. cit.*, p. 140), has quoted that in " form this shell is more globose and inflated than the other sinistral Helices", but this statement does not appear to be quite correct, as the shell of *Ariophanta kadapaensis* is markedly more globose, higher and inflated than that of the present species.

Genus **Indrella** Godwin-Austen, 1901

The shell is dextral, large, very thin, imperforate, with plicated striae and feebly impressed spiral lines. The whorls are few (three and half in number), rapidly enlarging, the body whorl being very large and rounded, and the aperture very wide and oblique, with the columellar margin arched inwards. The animal is somewhat larger than the shell and not completely retractile within the shell, and without shell lobes.

A single species, *Indrella ampulla*, which is the type of the genus and which is the only species of the genus recorded in India, is represented in the Museum collection.

Indrella ampulla (Benson)

Plate XVII, figs. 2*a* to 2*c*

Helix ampulla, Benson, Ann. & Mag. Nat. Hist., (2), V, 1850, p. 213.
Helix ampulla, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 123, fig. 736.
Helix ampulla, Pfeiffer, Mon. Helic. Viv., III, 1853, p. 27 ; IV, p. 9 ; VII, 1876, p. 57.
Helix ampulla, Blanford, Journ. Asiatic Soc. Bengal, XXXIV, 1866, p. 39.
Helix ampulla, Hanley & Theobald, Conch. Indica, 1876, p. 13, pl. 25, fig. 4.
Paraphanta ampulla, Theobald, Cat. Shells Brit. India, 1876, p. 17.
Nanina ampulla, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 54.
Indrella ampulla, Godwin-Austen, Proc. Malacol. Soc. London, IV, 1901, p. 187 ; pl. 187, pl. 18 (animal and anatomy).
Indrella ampulla, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 49.

The shell is rather large, globose, inflated, very thin, mostly horny, obliquely ovoid and imperforate. The spire is small, depressed, slightly convex, with an obtuse apex. There are three and half whorls, rapidly enlarging from above downwards, the body whorl being disproportionately large, globosely inflated and rounded at the periphery and on the basal surface. The surface of the shell is sculptured throughout with fine, obliquely transpiral, plicated striae, decussated by feebly impressed spiral lines, which, on the body whorl take the form of fairly widely set shallow, irregular grooves. The aperture is very large, oblique and broadly and ovately

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rounded. The interior of the aperture is horny brown, smooth and glossy. The peristome is thin, membranaceous and breaks off easily, and consequently the edge of the peristome is seldom found perfectly entire in preserved specimens. The columellar margin is strongly curved inwards. The substance of the shell is largely composed of the horny periostracum, which is very prominent, and makes up more than half the thickness of the shell, reducing the calcareous portion to a very thin layer. The shell is generally brownish olive or horny brown with a dull gloss, sometimes of a darker, almost rufous brown colour. The animal is greenish yellow in life, similar to that of *Ariophanta*, but larger and not fully retractile within the shell. The sole of the foot is smooth and undivided. Shell lobes are absent. The soft parts are pale creamy brown in spirit-preserved specimens. They have been observed to feed on large fungi in their natural haunts on the slopes of hills.

Recorded localities : Western slopes of the Wynaad, Nilgiris and Anamalai Hills. The locality " Anamullays Malabar " recorded by Theobald (*loc. cit.*) is rather vague, as Malabar is a separate district, and is not cited for this species by any of the other authors. However, the Museum collection contains specimens from South Malabar and Cochin, and specimens collected from reeds in Kadamane Estate, Hassan District, Mysore State, are represented in the Madras Christian College collection.

Specimens in the collection : One moderate-sized, rather young, dry-preserved, empty shell, brownish olive in colour, and very thin and fragile, from the Anamalais ; one large adult, and one half-grown spirit-preserved shell with the soft parts well extended, from Dhoni Forest, South Malabar ; and two small, medium-sized spirit-preserved shells with their soft parts intact, but rather broken, from Kavalai, Cochin Forest. The shells of the spirit-preserved specimens are all deep reddish brown in colour. Measurements (of the larger of the two spirit-preserved shells from Dhoni Forest, South Malabar) : Diameter : Major : 57 mm. ; minor : 40 mm. ; axis : 35 mm. ; aperture (oblique width) : 36.5 mm. ; (oblique height) : 33 mm. These are well over the average dimensions cited by Blanford and Godwin-Austen (*loc. cit.*) but large shells over 63 mm. in major diameter have been collected. The shells bear a superficial resemblance in shape to those of some species of *Natica* with depressed spires, such as *Natica lamarckii*, although the latter are quite thick and solid and differ entirely in the nature of the columella.

Sub-family GIRASIINAE

The shell is usually small, with few whorls, and either partly or entirely covered by the shell lobes.

Genus **Mariaella** Gray, 1855

(Syns. **Tennentia** Humbert, 1862 ;

Vega Westerlund, 1887 ;

Dekhania Godwin-Austen, 1888)

The shell is calcareous, elongately ovate, somewhat convex above, and feebly concave below, with a small apex situated on the right side, near the hind end. The animal is long and slug-like,

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with the lobes of the mantle united into an oval shield and almost completely covering the shell, with only a minute aperture left open.

Only two species of this genus are recorded within India, *viz.*, *M. dussumieri* and *M. beddomei*, and both these are represented in the Museum collection.

Mariaella dussumieri Gray

Plate XVII, figs. 3*a* and 3*b*

Mariaella dussumieri, Gray, Cat. Pulm., Brit. Mus., 1855, p. 63.
Viquesnelia dussumieri, Fischer, Journ. de Conchyl., 1856, p. 290, pl. 3, fig. 18.
Mariaella dussumieri, Webb, Proc. Malacol. Soc. London, III, 1878, p. 153, pl. 9, figs. 1–6 (animal, shell and anatomy).
Mariaella dussumieri, Cockerell, Nautilus, XII, 1898, p. 9.
Mariaella dussumieri, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1899, p. 113, pl. 93, figs. 1–1*c*, 2–2*c* (animal, shell and anatomy).
Tennentia thwaitesi, Humbert, Rev. et Mag. Zool., 1862, p. 42, pl. 17, fig. 1.
Tennentia thwaitesi, Semper, Reise Philip., Wiss. Res., 1870, p. 7.
Vega nordenskioldi, Westerlund, Vega-Exped., IV, 1887, p. 188, pl. 2.
Mariaella dussumieri, Blanford & Godwin-Austen, Fauna Brit., India, Mollusca, 1908, p. 205.

Cockerell (*loc. cit.*) was of opinion that the present species was the same as *M. beddomei*, and that these were synonymous, but Godwin-Austen (*loc. cit.*) who later re-examined some specimens of this genus found that the shell as well as the animal of *M. dussumieri* differed in several points from those of *M. beddomei*, and hence treated the two as distinct species. The shell differs from that of *M. beddomei* in being thin, membranaceous and translucent on the margin, while in *M. beddomei* it is thicker, more solid and more calcareous. The shell of the present species is slightly convex, ovate, whitish and somewhat variable in form. It may be either quadrate or narrower and longer with the apex larger. The animal is fairly large, growing to a length of eight inches, but usually smaller. It is pale yellowish brown, olivaceous green or olivaceous brown, occasionally bluish black, and generally mottled with dark blotches. The sole of the foot is broad, smooth and velvety, while the sides of the foot are finely papillate and feebly and irregularly furrowed. The foot is broad and truncate in front, and rather narrow and obtusely pointed behind. The mantle bears two narrow, raised ridges on the shell lobes, one extending from the shell aperture round the left margin of the shell and the other towards the respiratory orifice on the right margin. The longitudinal pallial furrows at the lateral edges of the foot are conspicuous, beneath which there is a series of short, black, vertical lines. Behind the ovate mantle shield, the body is sharply keeled medially on the dorsal side and terminates in the large mucus pore at the hind end.

Recorded localities : The Western Ghats, as far north as the Kadur District, Mysore ; Mahé on the West Coast, near Tellicherry ; hilly regions of Ceylon. A young specimen (less than two inches in length) collected from Mahableshwar, near Bombay, is recorded by Blanford and Godwin-Austen.

Specimens in the collection : A single, spirit-preserved specimen from the Netterikal Region, Kalakkad Forest, Tinnevelly District (altitude : 3,000 to 5,000 feet), collected by Prof. E. Barnes and identified by Dr. Baini Prashad. The specimen is olive-brown, slightly darker above and

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paler below, the sole of the foot being smooth, glossy and pale yellowish brown. Measurements : length : 60 mm. ; maximum width : 22 mm. ; maximum height : 25.5 mm.

The surface of the mantle shield is also seen to be finely papillated under the lens in this specimen, although the papillae on the sides of the foot are comparatively coarser. The respiratory orifice near the front end on the right side is quite distinct. The tentacles are seen as short, stubby and cylindrical structures, projecting out from beneath the front edge of the mantle shield.

Mariaella beddomei (Godwin-Austen)

Plate XVIII, figs. 1*a* and 1*b*

Girasia (*Dekhania*) *beddomei*, Godwin-Austen, Land & Freshwater Mollusca of India, I, 1888, p. 243, pl. 58, figs. 1–1*b* (animal) ; 2–2*b* (shell) ; pl. 62, figs. 7–7*a* (jaw and radula).
Mariaella beddomei, Webb, Proc. Malacol. Soc. London, III, 1898, p. 154, pl. 9, fig. 7.
Mariaella (*Dekhania*) *beddomei*, Godwin-Austen, Land & Freshwater Mollusca of India, II, 1899, pp. 113 and 114.
Mariaella beddomei, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 206.

The statement made by Blanford and Godwin-Austen (*loc. cit.*, p. 206), *viz.*, " Shell thinner than in *M. dussumieri* " is apparently incorrect, since in *M. beddomei* the shell is actually thicker, more solid and more strongly calcareous than in *M. dussumieri*, and Godwin-Austen (*loc. cit.*, 1899, p. 114) himself has referred to this difference. The shell is oval in shape, flat and smooth beneath, rather depressedly convex above, whitish and closely sculptured with concentric growth striae. The apex is solid. The animal is rather variable in colour. It is more or less similar to that of the preceding species, but larger, attaining an average length of four inches in the fully extended state. The posterior part of the body is about equal in length to the portion covered by the mantle shield in front. The dorsal and shell lobes are united in an oval mantle shield, almost completely enveloping the shell, and leaving only a minute aperture in the posterior median side. From this opening a well defined ridge runs towards the respiratory orifice on the right side indicating the line of union of the right and left shell lobes. There are no raised ridges on the shell lobes. The hind extremity of the foot is more or less squarely truncate, and not pointed as in the preceding species. The mucus pore is a narrow, vertical slit. Unlike the preceding species, the mantle is smooth, and not papillate. The shell and mantle rest in a well defined depression the outline of which is broad and squarish behind, not pointed. The typical form is uniformly pale ochraceous brown in colour, with a narrow, dark line on the keeled ridge of the foot behind, but deep greyish black (var. *nigra*) and blotched (var. *maculosa*) forms are also known. The dorsum is relatively more depressed in this species than in the preceding one.

Recorded localities : Travancore Hills.

Specimens in the collection : Seven spirit-preserved specimens, all from Pulney Hills (altitude : 6,500 to 7,500 feet), Kodaikanal, collected by Dr. Gravely and identified by Dr. Baini Prashad. It is rather surprising that this species should have been recorded previously only from Travancore Hills. Of the seven specimens in the collection, one, mounted as a gallery exhibit, is uniformly pale yellowish white, while all others are of various shades of brown, ranging from pale ochraceous brown to dark brown, and one of them bears traces of dark blotches on the sides of the posterior

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half of the foot. The dark line on the dorsal keel of the body behind the mantle shield is very distinct in most specimens. The sole of the foot is smooth and much paler, being mostly yellowish brown and the reticulated furrows on the sides of the foot are quite distinct. Measurements (of a full-grown specimen) : Length : 62 mm. ; height : 15 mm. ; width : 13 mm. These measurements are naturally not very typical as they represent those of a spirit-preserved specimen which has contracted considerably. Specimens in the living condition are much larger and may attain a length of four inches and a thickness of nearly an inch.

SERIES ACAVACEA

Family ACAVIDAE

The shell is large or moderate-sized, usually broader than high, imperforate, rarely umbilicated. The peristome is usually expanded.

Genus **Acavus** Montfort, 1810

The shell is imperforate, brightly coloured, ranging from a depressedly globose to a more or less globularly conoidal shape. The embryonic shell, composed of several of the earlier whorls, is about one-third of the diameter of the adult shell. The whorls become rapidly enlarged from above downwards, and the body whorl is downwardly deflected in front. The aperture is very oblique and the peristome brightly coloured and broadly expanded. The columellar margin is widened and obliquely descending.

Acavus haemastoma (Linné)

Plate XVIII, figs. 2*a* and 2*b*

Helix haemastoma, Linné, Syst. Nat. Ed. 10, I, 1758, p. 773.
Helix haemastoma, Férussac, Hist. Nat. Moll., 1821, pl. 32*b*, figs. 1, 2 and 5.
Helix haemastoma, Sowerby, Conch. Man., 1839, fig. 267.
Helix haemastoma, Reeve, Conch. Icon., VII, 1852, pl. 71, fig. 366.
Helix haemastoma, Adams, Genera of Recent Mollusca, 1858, pl. 77, fig. 6*a*.
Helix haemastoma, Semper, Reisen Arch. Philippinen, 2, III, 1870, p. 99, pl. 12, figs. 8–10 (anatomy).
Helix haemastoma, Hanley & Theobald, Conch. Indica, 1875, p. 51, pl. 127, fig. 2.
Acavus haemastoma, Theobald, Cat. Shells Brit. India, 1876, p. 25.
Acavus hemastomus, Montfort, Conch. Syst., II, 1810, p. 235, pl. 59.
Acavus hemastomus, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 287.
Helix (*Acavus*) *haemastoma*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 80.
Acavus haemastoma, Adams, Genera of Recent Mollusca, II, 1852, p. 195, pl. 77, fig. 6*a*.
Helix [*Macroön* (*Acavus*)] *haemastoma*, Pilsbry, Man. Conch., ser. 2, VI, 1890, p. 78, pl. 18, figs. 22–25.
Acavus haemastomus, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 154, pl. 38, fig. 1 (shell) ; pl. 48, fig. 14, pl. 50, fig. 3 (anatomy).
Acavus haemastomus, Randles, Proc. Malacol. Soc. London, IV, 1900, p. 103, pl. 9, figs. 9 and 12 (anatomy).
Acavus haemastoma, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 45.

This is the best known species of *Acavus*, and although the range of the genus *Acavus* is cited as Ceylon by Gude (*loc. cit.*), the present species appears to have a wider range, as there are specimens of this species in the Museum collection from Sivaganga—a locality from which this species has not been recorded.

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The shell is more or less globular and inflated, with a broadly and depressedly conoid spire, solid, with a dull gloss on the surface. The whorls are five in number, rapidly increasing in size, the body whorl being inflated and rounded at the periphery and rather strongly inclined downwards towards the apertural end. The surface is traversed throughout by fine, close-set, obliquely transpiral striae, which, under the lens, are seen to be decussated by finely impressed, rather irregularly spaced spiral lines. The aperture is strongly oblique, and broadly rounded, with a widely expanded and reflected peristome. The columellar border is long, oblique and strongly curved towards the base. The shell is dull glossy whitish, the three uppermost (embryonic) whorls being of a deep fleshy, blackish brown colour, and the two whorls immediately below them being tinged or spirally banded with purple. The interior of the aperture and the parietal wall of the body whorl (which is covered by a thick callus deposit) are of a deep reddish brown colour, while the flattened edge of the peristome on the inside is glossy and pure whitish all round. The species owes its specific name to the deep colour of the interior of the aperture, " *haemastoma* " literally meaning " blood-mouthed ".

Recorded localities : Ceylon ; Galle, Ceylon. The species has also been recorded from Coromandel and Nicobars doubtfully, but Gude (*loc. cit.*) states that these have not been confirmed, and hence have to be disregarded.

Specimens in the collection : Three empty, dry-preserved shells—all from Sivaganga. All the three shells are whitish throughout, except the apex and the uppermost whorls which are deep purplish brown, although Pilsbry's original description states that " the whole surface above the periphery is usually of a reddish brown hue ". The present specimens are apparently partially bleached. There is considerable variation in the spiral banding of the shell in this species. Only one of the three shells bears a well defined, narrow, purplish spiral band running along the middle of the second and third whorls of the spire. The interior of the aperture is deep snuff-brown in colour. All the three shells are of about the same size. Measurements : Diameter : Major : 32 mm. ; minor : 24.5 mm. ; altitude : 17.5 mm. ; aperture : height : 11.5 mm. ; width : 13 mm. The shells are considerably smaller than the typical one cited by Gude (*loc. cit.*), the major diameter of which is quoted as 49 mm. (from Ceylon).

Acavus waltoni (Reeve)

Plate XVIII, figs. 3*a* and 3*b*

Helix valtoni, Reeve, Proc. Zool. Soc. London, 1842, p. 49.
Helix waltoni, Pfeiffer, Mon. Helic. Viv., I, 1847, p. 19.
Helix waltoni, Férussac, Hist. Nat. Moll., p. 303, pl. 93, figs. 1–2.
Helix waltoni, Reeve, Conch. Icon., VII, 1852, pl. 72, fig. 372.
Helix waltoni, Hanley & Theobald, Conch. Indica, 1876, p. 51, pl. 127, fig. 1.
Acavus waltoni, Theobald, Cat. Shells Brit. India, 1876, p. 25.
Helix (*Acavus*) *waltoni*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 81.
Helix (*Acavus*) *waltoni*, Cooke, Cambridge Natural History, III, 1895, p. 304, fig. 204.
Oligospira waltoni, Ancey, Conch. Exch., II, 1887, p. 22.
Helix [*Macroōn* (*Acavus*)] *waltoni*, Pilsbry, Man. Conch., ser. 2, VI, 1890, p. 83, pl. 18, figs. 20 and 21.
Acavella waltoni, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 288.
Acavus valtoni, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 154.
Acavus waltoni, Randles, Proc. Malacol. Soc. London, IV, 1900, p. 103 ; pl. 9, figs. 6 (radula), 10 and 15 (anatomy).
Acavus waltoni, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 51.

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The shell is fairly thick, solid and depressedly ovoid. The spire is depressed and flattened. The whorls rapidly enlarge from above downwards, the body whorl being large, inflated, rounded at the periphery and inclined downwards towards the apertural end. The aperture is large, broad and more or less squarish, with the peristome strongly thickened, expanded and sharply reflected out. The columellar margin is strongly arched and covered with a heavy callus deposit. There is considerable variation in the colouration and sculpture of the shell. The shell is typically reddish brown, with somewhat dull whitish, more or less glistening patches on the periostracum, which may either be obsolete or disposed so as to form regular patterns such as spiral bands. The peristome and the parietal wall of the body whorl are of a deep blackish brown or purplish brown colour, and the interior of the aperture is fleshy pink. The sculpture typically consists of fine, close-set, transpiral striae which are rendered granular in the upper whorls by impressed spiral lines ; in some shells the body whorl is also traversed by spiral lines.

Recorded localities : Ceylon.

Specimens in the collection : A single, empty, dry-preserved shell from Ambeyamda, Ceylon. The whitish, shining patches on the surface are disposed in the form of spiral bands of varying widths. Measurements : Diameter : Major : 48 mm. ; minor : 35 mm. ; height : 28 mm. ; aperture : height : 17 mm. ; width : 19 mm.

Acavus skinneri (Reeve)

Plate XVIII, figs. 4*a* and 4*b*

Helix skinneri, Reeve, Conch. Icon., VII, 1854, pl. 197, fig. 1387.
Helix skinneri, Semper, Reisen Arch. Philippinen, Wis. Res. 2, III, 1870, p. 100 ; pl. 12, fig. 7 (anatomy) ; pl. 16, fig. 5 (radula).
Helix skinneri, Hanley & Theobald, Conch. Indica, 1876, p. 45, pl. 111, fig. 1.
Acavus skinneri, Theobald, Cat. Shells Brit. India, 1876, p. 25.
Helix (*Acavus*) *skinneri*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 81.
Acavus skinneri, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 154 ; pl. 50, figs. 1, 8 and 26 (anatomy).
Acavus skinneri, Randles, Proc. Malacol. Soc. London, IV, 1900, p. 103 ; pl. 9, fig. 5 (anatomy).
Oligospira skinneri, Ancey, Conch. Exch., II, 1887, p. 22.
Helix [*Macroön* (*Acavus*)] *skinneri*, Pilsbry, Man. Conch., ser. 2, VI, 1890, p. 84, pl. 18, figs. 17–19.
Acavella skinneri, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 288.
Acavus skinneri, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 52.

The shell is depressedly globose, thick and solid, and more or less ovoid and *Natica*-like in shape, with a low, depressed and very slightly convex spire, and a large, inflated and obliquely produced body whorl. The whorls are three to four in number, rapidly enlarging from above downwards, and the sutures are well impressed. The aperture is broad and squarish, with a broadly thickened peristome, covered on the outside with a thick deposit of callus on the reflected portion of the lip. The interior of the aperture and the columellar margin are also densely covered with callus. The surface of the body whorl is minutely granulated throughout. Besides, the body whorl bears distinct, rather regularly and widely spaced, but feebly raised spiral ridges, while the upper whorls are traversed by fine, impressed spiral lines decussating the transpiral striae as in the preceding species. The shell is chestnut-brown in colour, ornamented with whitish or pale yellowish brown, freckled markings which are disposed more or less in the form of wavy

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transpiral bands. These markings are more conspicuous on the whorls of the spire and over the upper part of the body whorl. The interior of the aperture is purplish. The callus deposit on the outside of the peristome is characteristic, its surface being traversed by deeply incised transpiral striae.

Recorded localities : Ceylon ; Upper Onavah, Ceylon.

Specimens in the collection : A single, empty, dry-preserved shell, rather pale chestnut-brown in colour, from Uva, Ceylon. Measurements : Diameter : Major : 31.5 mm. ; minor : 24 mm. ; height : 18.5 mm. ; aperture : height : 11 mm. ; width : 12.5 mm.

SERIES HELICACEA

Family PLEURODONTIDAE

The shell is variously shaped, with or without an umbilicus, lenticular, elongately ovoid, or turretted. The aperture sometimes bears teeth or ridges, and the outer lip is as a rule expanded or reflected out.

Genus **Planispira** Beck, 1837

The shell is as a rule umbilicated, with a more or less depressed spire. The embryonic shell is not granulated or striated. The body whorl is convex beneath and the aperture more or less oblique, with the peristome expanded or reflected and sometimes toothed below.

Planispira fallaciosa (Férussac)

Plate XIX, figs. 1*a* to 1*c*

Helix (*Helicella*) *fallaciosa*, Férussac, Tabl. Syst. Limacons, 1821, p. 43 (nom. nud.).
Helix fallaciosa, Pfeiffer, Hist. Helic., II, 1842, p. 27.
Helix fallaciosa, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 85, fig. 459.
Helix fallaciosa, Hanley & Theobald, Conch. Indica, 1876, p. 36 ; pl. 85, figs. 8 and 9.
Trachia fallaciosa, Theobald, Cat. Shells Brit. India, 1876, p. 26.
Helix (*Planispira*) *fallaciosa*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 77.
Planispira (*Trachia*) *fallaciosa*, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 116.
Trachia fallaciosa, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 285.
Planispira fallaciosa, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 59.
Planispira fallaciosa, Gude, Fauna Brit. India, Mollusca. II, 1914, p. 157.
Planispira fallaciosa, Satyamurti, Bull. Mad. Govt. Mus. (Nat. Hist.), I, No. 2, pt. 6, 1952, p. 254 ; pl. 34, figs. 5*a* and 5*b*.

As this species has been previously recorded by me from Pamban in the earlier Bulletin on the Mollusca of Krusadai Island cited above (Satyamurti, *loc. cit.*), I quote below my previous description of the shell of this species for ready reference : " The shell is depressed and more or less lenticular, with a flattened spire, the apex of which is scarcely raised above the general level of the whorls. The sutures appear as well impressed grooves. The surface of the whorls is finely transpirally striated, and very minutely punctured all over. The whorls are very slightly convexly raised above, and the peripheral portion of the body whorl is sharply but evenly rounded.

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The basal surface of the body whorl is strongly convex and more or less angular, adjacent to the umbilicus. The body whorl is expanded towards the aperture which is strongly oblique and ovately rounded ; the outer lip of the aperture is slightly thickened and reflected out, and on the columellar side the margins of the aperture approach each other and are united by a thin sheet of callus ; the basal margin of the aperture is nearly straight ; the columellar part of the outer lip slightly overhangs the umbilicus. The umbilicus is large, circular and perspective. The shell is whitish or pale horny brown with dark brown spiral bands just below the sutures, and one just above the periphery followed by two or more narrower ones below." The shell, however, is variable in its colouration and colour pattern, being either uniformly whitish or pale to dark brownish, or variously banded with brown. Specimens of this species are said to be abundant at Adyar and Tondiarpet during the monsoons. They are gregarious, and living specimens may be found in considerable numbers among fallen and decaying leaves in gardens and orchards or under large stones and logs of wood. The animal is slow in its movements, carrying the shell in an oblique position when crawling.

Recorded localities : Pamban, Madras City, Adyar, Tondiarpet, Ennur, Tiruchirapalli, Coimbatore, the Koondah Hills and Ceylon.

Specimens in the collection : A few empty dry-preserved shells from Pamban and Madras City. One of the shells from Madras bears a broad, supra-peripheral as well as a broad, infra-peripheral brown spiral band, beyond which several narrower bands are present, both above and below. Measurements : Diameter : Major : 13 mm. ; minor : 11.5 mm. ; height : 6.5 mm. These measurements are more or less the average ones for shells of this species.

Planispira vittata (Müller)

Plate XIX, figs. 2*a* and 2*b*

Helix vittata, Müller, Verm. terr. fluv., II, 1774, p. 76.
Helix vittata, Wood, Index Test., 1825, pl. 34, fig. 93.
Helix vittata, Deshayes, in Férussac, Hist. Nat. Moll., I, 1850, p. 233.
Helix vittata, Adams & Reeve, Zoology of the Voyage of H.M.S. " Samarang ", 1850, Mollusca, p. 60, pl. 15, figs. 7*a*, *b* and *c*.
Helix vittata, Reeve, Conch. Icon., VII, 1852, *Helix*, pl. 78, fig. 412.
Helix vittata, Hanley & Theobald, Conch. Indica, 1876, p. 52 ; pl. 130, fig. 10.
Trachia vittata, Theobald, Cat. Shells Brit. India, 1876, p. 26.
Helix (*Helicogena*) *vittata*, Férussac, Hist. Nat. Moll., 1822, pl. 25*A*, fig. 9 ; pl. 26, figs. 4–6.
Helix (*Planispira*) *vittata*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 76.
Planispira (*Trachia*) *vittata*, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 115 (anatomy) ; p. 116, pl. 9, fig. 24 (shell).
Helix (*Eurystoma*) *vittata*, Godwin-Austen, Proc. Malacol. Soc. London, VI, 1904, p. 48, pl. 4.
Eurystoma vittata, Jousseaume, Mém. Soc. Zool. France, VII, 1894, p. 286.
Planispira vittata, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 164.
Helix (*Planispira*) *vittata*, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 149.
Planispira vittata, Satyamurti, Bull. Mad. Govt. Mus. (Nat. Hist.), I, No. 2, pt. 6, 1952, pt. 255, pl. 34, fig. 5.

This species has also been recorded from Pamban along with the preceding species in my account of Pamban Molluscs, and my earlier description of the shell of this species (Satyamurti, *loc. cit.*) is therefore quoted below for ready reference : " The shell is larger, thicker and more solid than in the preceding species (*i.e.*, *P. fallaciosa*), and is much less strongly depressed, the

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spire being distinctly convex. The uppermost whorls of the spire are smooth and glossy, and somewhat blackish or smoky brown, but the rest of the surface is finely transpirally striated and minutely granulated all over. The sutures are impressed and the apex obtusely rounded. The body whorl is somewhat inflated and its basal surface evenly rounded and swollen ; it is considerably widened towards the aperture, which is strongly oblique, but of greater vertical extent than in the preceding species (i.e., *P. fallaciosa*). The outer lip is rather widely expanded and reflected at the margin ; its basal margin is nearly straight, while the outer and upper margins are curved. The umbilicus is small and appears as a deep, narrowly circular opening. The columellar margin is expanded into a distinct sheet of callus which overhangs the umbilical opening considerably on that side. The shell is whitish, ornamented irregularly with pale brownish bands of varying widths. The interior of the aperture is dark horny brown." The embryonic whorls are smooth, shining and purplish or blackish brown. This is a small, dark-banded land snail common everywhere in the Tinnevelly and Ramnad Districts on babul thorns and other bushes. They are generally avoided by birds on account of their bad taste. The shell is rather variable, particularly in its banding.

Recorded localities : Tranquebar, Coromandel, Tiruchirapalli, Malabar, Travancore, Ramnad and Tinnevelly Districts ; Ceylon.

Specimens in the collection : A few dry empty shells from Pamban, Ramnad District. The interior of the aperture is bright reddish brown. Measurements (average) : Diameter : Major : 23 mm. ; minor : 19.5 mm. ; height : 15.5 mm. These measurements are within the average range of size cited by Gude (*loc. cit.*).

Planispira nilagerica (Pfeiffer)

Plate XIX, figs. 3*a* to 3*c*

Helix nilagerica, Pfeiffer, Proc. Zool. Soc. London, 1845, p. 130.
Helix nilagerica, Reeve, Conch. Icon., VII, 1852, pl. 84, fig. 450.
Helix nilagerica, Pfeiffer, Conch. Cab., *Helix*, II, 1853, p. 92, pl. 82, figs. 15–17.
Helix nilagerica, Hanley & Theobald, Conch. Indica, 1876, p. 26, pl. 55, figs. 6 and 7.
Trachia niligirica, Theobald, Cat. Shells Brit. India, 1876, p. 26.
Helix (*Trachia*) *nilagirica*, von Martens, Die Heliceen, Ed. 2, 1860, p. 160.
Helix (*Planispira*) *nilagirica*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 77.
Helix [*Plectotropis* (*Trachia*)] *nilagherica*, Tryon, Man. Conch., ser. 2, IV, 1888, p. 65, pl. 14, figs. 70 and 71.
Planispira (*Trachia*) *nilagirica*, Pilsbry, Man. Conch., ser. 2, IX, 1894, p. 116.
Planispira nilagerica, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 159.

The shell is smaller and more strongly depressed than that of the preceding species, being discoidal, with the upper surface almost completely flattened. The spire is depressed and horizontally flattened. The whorls are five in number, gradually and regularly increasing in size, and each whorl is more or less convexly inflated above. The body whorl is rather abruptly inclined downwards towards the apertural end. The umbilicus is wide, more or less perspective, the under side of the shell being characteristically convolute. The aperture is almost horizontal and ovately rounded. The peristome is thin, continuous and slightly reflected. The shell in the fresh condition bears a deciduous periostracum, bearing short, stiff, close-set hairs, beneath which the surface of the shell is closely and finely granulated. The colour and ornamentation of the shell are somewhat variable. There is a narrow, brownish, supra-peripheral spiral band,

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but this is lacking in many specimens. The shell may be uniformly pale ochre-brownish or ornamented with transpiral alternately dark and light brown bands. Some shells have the distal part of the body whorl dark brownish.

Recorded localities : Nilgiris, Tiruchirapalli.

Specimens in the collection : Two dry-preserved shells from Nilgiris. Both are whitish, with a dull, translucent gloss on the surface, and in one of them there is a faint indication of the supra-peripheral brownish spiral band on the body whorl. Measurements : Diameter : Major : 11 mm. ; minor : 9 mm. ; height : 4 mm.

Genus **Amphidromus** Albers, 1850

The shell is either dextral or sinistral, usually elongately ovoid and smooth, with a conical spire and feebly inflated whorls. The aperture is somewhat oblique, ovate, and without denticles, The peristome is more or less thickened, expanded or reflected, the columellar margin being reflected and sometimes bearing a feebly developed fold.

Sub-genus **Beddomea** Nevill, 1878

The shell is usually dextral, umbilicated, sometimes angular, white, or with brownish bands or streaks. This sub-genus is very closely allied to *Amphidromus* s. str. and takes the place of the latter in Southern India and Ceylon where the typical *Amphidromus* does not occur.

Amphidromus (**Beddomea**) **intermedius** (Pfeiffer)

Plate XIX, figs. 4*a* and 4*b*

Bulimus intermedius, Pfeiffer, Proc. Zool. Soc. London, 1854, p. 291.
Bulimus intermedius, Hanley & Theobald, Conch. Indica, 1876, p. 10, pl. 19, figs. 6 and 8.
Geotrochus intermedia, Theobald, Cat. Shells Brit. India, 1876, p. 26.
Amphidromus (*Beddomea*) *intermedius*, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 127.
Amphidromus (*Beddomea*) *intermedius*, Pilsbry, Proc. Malacol. Soc. London, IV, 1901, p. 158, pl. 16, figs. 2, 4, 6 and 7 (anatomy).
Cochlostyla (*Phengus*) *intermedia*, Pfeiffer & Clessin, Nomencl. Helic. Viv., 1881, p. 210.
Buliminus (*Beddomea*) *intermedius*, Kobelt, Conch. Cab., Family Buliminidae, 1900, p. 679, pl. 103, figs. 2 and 3.
Amphidromus (*Beddomea*) *ceylanicus* var. *intermedius*, Pilsbry, Man. Conch., ser. 2, XIV, 1901, p. 6, pl. 1, figs. 10–12.
Amphidromus intermedius, Gude, Fauna Brit. India, Mollusca, II, 1914, p. 191.

The shell is narrowly perforate, elongately ovoid, with a well raised and conical spire, and a somewhat obtuse apex. The sutures are simple and slightly impressed. The whorls are six in number, with rather flattened walls, except the body whorl which is slightly inflated and ovoid. The height of the body whorl is roughly about half the entire height of the shell. The body whorl is subangulate around the periphery just below the middle. The aperture is oblique and ovately truncated. The peristome is strongly reflected and the columellar margin triangularly expanded and flattened. The umbilicus is partly covered by the expanded columella. The shell is white, practically smooth, and glossy, with the surface finely and obliquely transpirally striated and punctured.

Recorded localities : Ceylon.

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Specimens in the collection : One dry shell from Watawala, Ceylon, with part of the shell wall broken away in the whorl next above the body whorl. It is dull creamy white, glossy and minutely striated. Measurements : Length : 36 mm. ; maximum diameter : 16.5 mm. ; aperture (including the peristome) : height : 18 mm. ; width : 13 mm. ; internal width : 8 mm.

SERIES STREPTAXACEA

Family STREPTAXIDAE

The shell (which is absent in certain genera) is spiral, dextral, as a rule transparent and colourless, smooth, striated or with radiating furrows, very variable in shape, ranging from a depressedly top-shape to an elongately tower-shape. The animal is carnivorous, and either slug-like or snail-like.

The majority of genera of this family are foreign ; only two genera are represented in India, both of them bearing a shell ; they may be readily distinguished as follows :—

Shell depressed, heliciform, the body whorl being excentric ... *Streptaxis*.
Shell elongated and pupiform ... ... *Ptychotrema*.[1]

Genus **Streptaxis** Gray, 1837

The shell is generally thin, translucent and more or less widely umbilicated, rounded and top-shaped, smooth or rib-striated either over the entire surface or just below the sutures only. The body whorl is sometimes somewhat irregular and excentric. The aperture is toothless, sometimes with a lamella on the penultimate whorl, and with one or two tooth-shaped thickenings in the apertural margin.

Streptaxis peroteti (Petit)

Plate XIX, figs. 5*a* and 5*b*

Helix peroteti, Petit, Rev. Zool., 1841, p. 100.
Helix peroteti, Pfeiffer, Mon. Helic, Viv., I, 1847, p. 9 ; *H. perrotteti*, III, 1853, p. 288 ; *H. perroteti*, VII, p. 496.
Streptaxis perotteti, W.T. & H.F. Blanford, Journ. Asiatic Soc. Bengal, XXX, 1861, p. 349.
Streptaxis peroteti, Hanley & Theobald, Conch. Indica, 1876, p. 40, pl. 98, figs. 5 and 6.
Streptaxis perrotteti, Theobald, Cat. Shells Brit. India, 1876, p. 33.
Streptaxis perotteti, Nevill, Hand List Moll. Ind. Mus., I, 1878, p. 4.
Streptaxis perotteti, Blanford, Journ. Asiatic Soc. Bengal, XLIX, pt. 2, 1880, p. 205.
Streptaxis latior, Gude, Proc. Malacol. Soc. London, V, 1903, p. 323, pl. 12, figs. 1–4.
Streptaxis peroteti, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 10 ; fig. 8.

The shell is rather small, thin, obliquely ovoid, smooth and dull above, glossy beneath. The spire is convex, but rather depressed, with an obtuse apex. The whorls are five to six in number, more or less depressedly convex above. The body whorl is markedly excentric and somewhat produced towards the apertural side, and flattened on the basal aspect. The penultimate whorl extends beyond the body whorl on the side opposite to the apertural side, when

[1] The genus *Ennea* H. & A. Adams, 1855, to which the two species in the Museum collection belong, and under which name the several Indian species of the genus have been reported by Gude (Fauna Brit. India, Mollusca, II 1914), is treated by Thiele as a subgenus under *Ptychotrema* (Mörch) L. Pfeiffer, 1853. As we have followed Thiele's classification in the present paper, we have had to refer the species represented in the Museum collection to the genus *Ptychotrema*, although *Ennea* is more widely known as a generic name by the earlier authors.

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viewed from below. The body whorl is markedly indented or depressed just behind the peristomial margin. The aperture is oblique, broadly D-shaped, and the peristome somewhat reflected and expanded. The interior of the aperture bears two strong median parietal lamellae converging interiorly, (but in one of the two specimens examined there is only one lamella, and this appears to be quite a common variation), and the inside of the peristome bears three teeth, one on the upper border, one on the basal and one on the columellar border. The surface of the shell is finely and closely transpirally striated above, but smooth and polished below. The shell is pale yellowish white above, and almost pure white below. The shell is rather variable in the proportions of the length to the breadth and in the extent to which the penultimate whorl projects beyond the body whorl. The umbilicus is not appreciably covered by the reflected columellar margin.

Recorded localities : Nilgiris, Anamalais, Tinnevelly. Nevill specifically records this species from Ootacamund and Coonoor in the Nilgiris. A large variety of the typical form has been recorded from Ceylon by Col. Beddome.

Specimens in the collection : Two dry-preserved shells from Nilgiris, one slightly larger and with the body whorl more strongly produced. The smaller shell has two parietal lamellae (rather thin) and the larger shell has a single thick median parietal lamellae. As already mentioned, this is a frequent variation. Measurements (of the larger shell) : Length : 11 mm. ; width : 7.5 mm. ; height : 6 mm. These measurements are larger than the maximum dimensions cited for this species by Blanford and Godwin-Austen (*loc. cit.*).

Genus **Ptychotrema** (Mörch) L. Pfeiffer, 1853

The aperture of the shell bears one or two strong, raised, entering lamellae which are marked by corresponding external indentations or furrows.

Sub-genus **Ennea** H. & A. Adams, 1855

The shell is pupiform, elongately ovate and more or less spindle-shaped or turretted. The aperture bears only two palatal plaits or folds. The animal is similar to that of *Streptaxis*.

Ptychotrema (**Ennea**) **bicolor** (Hutton)

Plate XIX, figs. 6*a* and 6*b*

Pupa bicolor, Hutton, Journ. Asiatic Soc. Bengal, III, 1834, pp. 86 and 93.
Pupa bicolor, Pfeiffer, Mon. Helic. Viv., II, 1848, p. 352.
Pupa bicolor, Benson, Ann. & Mag. Nat. Hist., (2), IV, 1849, p. 125.
Ennea bicolor, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 342.
Ennea bicolor, Semper, Reis. d. Phil., III, 1890–94, pl. 8, fig. 14.
Ennea (*Huttonella*) *bicolor*, Stoliczka, Journ. Asiatic Soc. Bengal, XL, pt. 2, 1871, p. 169.
Pupa (*Ennea*) *bicolor*, Hanley & Theobald, Conch. Indica, 1876, p. 40 ; pl. 100, fig. 6.
Ennea bicolor, Theobald, Cat. Shells Brit. India, 1876, p. 32.
Ennea (*Huttonella*) *bicolor*, Nevill, Hand List Moll. Ind. Mus., 1878, p. 6.
Pupa mellita, Gould, Proc. Boston Soc. Nat. Hist., II, 1846, p. 98.
Pupa (*Ennea*) *ceylanica*, Pfeiffer, Proc. Zool. Soc. London, 1855, p. 9.
Pupa (*Ennea*) *ceylanica*, Pfeiffer, Mon. Helic. Viv., IV, 1859, p. 342.
Pupa (*Ennea*) *ceylanica*, Hanley & Theobald, Conch. Indica, p. 40 ; pl. 100, fig. 4.
Ennea bicolor, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 53.
Ennea bicolor, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 19, fig. 12.
Ennea bicolor, Annandale & Prashad, Rec. Ind. Mus., XIX, 1920, p. 189.
Ennea bicolor, Annandale & Rao, Rec. Ind. Mus., XV, 1923, p. 390.

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This is the type of the genus *Ennea*, and is the commonest and most widely distributed species of the genus, being found almost throughout India, Ceylon, Burma and Nicobar Islands. The species also occurs in Seychelles and in islands of the West Indies. Annandale and Prashad (*loc. cit.*) have given a detailed account of the armature of the aperture in the shell of this species.

The shell is small, subcylindrical, rather slender and elongated with a blunt apex. The shell is translucent and almost colourless, but not very thin. The whorls are about seven in number and only slightly inflated. The body whorl is laterally compressed and bears a funnel-shaped depression on each side. The indentation on the inner side surrounds the umbilicus which is closed. The surface of the shell is practically smooth and polished, but there is a fine sculpture consisting of very fine transpiral ribs which are strongly developed just below the suture on all except the apical whorls. The aperture is nearly vertical, subquadrate, but its outline is somewhat variable in shape and proportions. The peristome is white, expanded, slightly thickened and curved back into a sinus above at the angle. There is a strongly developed apertural armature consisting of two obtuse, somewhat compressed teeth and two elongate, internal parietal folds. The presence of this strong armature reduces the extent of the actual orifice and renders it trilobed. Between the two folds on the parietal wall is a broad, deep furrow which expands externally and along which the foot slides as the animal emerges. Of the two teeth, the outer one is marked externally by a funnel-shaped depression, but the internal or basal tooth is solid and not marked by any external indentation. The shell is rather variable in the extent to which it tapers above and in the shape and proportions of the apertural outline.

The animal has a slender and elongated body, strongly truncate in front, more or less yellowish. The head is reddish and the head and neck are covered with tubercles. The internal eye-bearing peduncles are of a deep saffron tint. The mantle is deep red. The foot is rather broad in front, narrower towards the tail. The animal inhabits moist places among moss and decaying vegetation and is generally found under stones and in crevices underneath the barks of trees. This is a carnivorous land snail and has been known to feed largely on living specimens of *Opeas gracile* (Hutton). The two species are often found in association with each other wherever they occur, but specimens of the latter are generally more abundant. Although *Ptychotrema* (*Ennea*) *bicolor* is a common and widely distributed species, it is rather rare in localities in and around Madras, and even here they are seldom seen except during the rains from November to January.

Recorded localities : Almost throughout India, Ceylon, Burma and Nicobar Islands, mainly in open plains. The following are some of the localities from which it has been specifically recorded : Poona, Salt Range, Cutch, Mirzapur, Calcutta, Mahé, Seychelles ; Mauritius ; Roorkee, Delhi ; Bhamo, Rangoon, Arakan ; Erode, Sinkip Island and Singapore. In Madras it has been recorded from Chepauk gardens and a few gardens in Vepery.

Specimens in the collection : A single dry-preserved shell, collected in the Museum Compound, Madras. It is pale yellowish brown in colour and slightly glossy. As the aperture has been secondarily filled up by calcareous concretions the details of the armature are not discernable in the present specimen. Measurements : Length : 6.5 mm. ; width : 2 mm. ; height of aperture : 1.5 mm.

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Ptychotrema (Ennea) bicolor race **barkudensis** (Annandale & Prashad)

Plate XIX, figs. 7*a* and 7*b*

Ennea bicolor race *barkudensis*, Annandale & Prashad, Rec. Ind. Mus., XIX, 1920, p. 191.

This is a race (or subspecies) of *Ennea bicolor* described in 1920 by Annandale and Prashad (*loc. cit.*) from Barkuda Island in the Chilka Lake in Orissa. The shell resembles that of the typical form in its structure, sculpture and details of its armature, but is considerably narrower than that of the typical form, the height being fully about four times the width at the base. It is also less strongly tapered towards the apex and adult shells have eight and half whorls instead of seven. The apex is generally somewhat inflated and the aperture is smaller and narrower than in *Ptychotrema* (*Ennea*) *bicolor* s. str. The colour of the soft parts of the animal resembles that of the typical form except that the bright vermilion colour is restricted to the internal structures connected with the eye peduncles. The remaining parts are lemon yellow and the mantle is orange-scarlet. Living specimens of this race have also been observed to feed on a species of *Opeas*, probably *Opeas annandalei*, specimens of which accompany them in far larger numbers on Barkuda Island. They are said to emerge from their crevices in wet weather in the evenings.

Recorded localities : Barkuda Island, Chilka Lake, Ganjam District, Orissa, where they were reported to be fairly common, but not abundant, in the latter half of June, 1920.

Specimens in the collection : Three dry-preserved shells from Barkuda Island, Ganjam District, Orissa. The shells are pale yellowish white, and are proportionately longer than those of *Ennea s. str.* Measurements : Length : 6.5 mm. ; maximum width : 1.5 mm. ; height of aperture: 1.5 mm.

Ptychotrema (Ennea) subcostulata (Blanford)

Plate XIX, figs. 8*a* and 8*b*

Ennea subcostulata, Blanford, Journ. Asiatic Soc. Bengal, XLIX, 1880, p. 206 ; pl. 2, fig. 14 (upper figure).
Ennea subcostulata, Blanford & Godwin-Austen, Fauna Brit. India, Mollusca, 1908, p. 21.

This species is closely allied to *Ptychotrema* (*Ennea*) *macrodon* recorded from Pykara Hills, Nilgiris. The shell is small, pupiform, somewhat turretted and practically smooth, but distinct indications of a fine, thread-like, vertical transpiral ribbing can be made out under the lens in the specimens examined, although they are often almost or altogether obsolete in the present species, but they are well developed in *P.* (*Ennea*) *macrodon*. The whorls are seven in number, separated by well impressed sutures, the spire terminating in an obtuse apex above. The body whorl is not indented. The aperture is vertical, semi-ovate and obliquely truncated above, its cavity being almost occluded by the thick teeth which, however, are less massive than in *P.* (*Ennea*) *macrodon*. There is a strong parietal plait, a small tooth on the right margin, a large lamellar basal tooth inside the lip and a blunt columellar tooth. In adult shells the basal tooth is represented by two tubercle-like teeth. The shell is pale horny brown and bears a translucent gloss.

Recorded localities : Shevroy Hills, South India.

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Specimens in the collection : Four dry-preserved shells from Shevroy Hills, out of which one appears to be immature and has only five whorls. The remaining three are full grown and have seven whorls each. Measurements : Length : 6 mm. ; maximum width : 2.5 mm. ; height of the aperture : 1.5 mm.

Class PELECYPODA
(= BIVALVIA)

The Class Pelecypoda or Lamellibranchiata includes shells popularly known as Bivalves and is most abundantly represented in the sea or on the sea shores. However, a small proportion of the species inhabit freshwater, the common freshwater mussel being a familiar example, but none occurs on land. The habits and habitats of freshwater Pelecypods vary somewhat in the different families. The Unionidae (which includes the freshwater mussels) are mainly (though not always) found on sandy bottoms in clear running water ; but some species lie almost buried in sand or mud at the bottom of pools and tanks with only the posterior side and the projecting siphons exposed. Members of the family Cyrenidae, including the freshwater clams, are generally found in sand or mud. *Scaphula*, a close freshwater relative of the marine genus *Arca*, is found both in brackish water in river deltas and in freshwater far in the interior.

Normally, the sexes are distinct, but cases of hermaphroditism are known, as in certain species of *Anodonta*. In the freshwater Pelecypods union of the sexes does not take place, the male germ cells being freely discharged into the water and taken in through the inhalent siphons of the female. The larval stages of freshwater Pelecypods are so different from the later and adult stages that they were at first taken to be quite a distinct form and described under the name *Glochidium*. It leads a parasitic existence attached to the body of a host such as a fish, by means of a hook-like process in the middle of each valve and a long byssal thread, and undergoes its metamorphosis into the adult which is a free-living animal, with a well developed foot and adductor muscles and with a new bivalve shell formed beneath the embryonic shell.

The species represented in the Museum collection of Freshwater Pelecypods belong to two families, the Unionidae and the Corbiculidae. They may be distinguished as follows :—

Shell nacreous, more or less transversely elongated, the valves being almost always longer than high. Umbones generally corrugately sculptured ... ... UNIONIDAE.

— Shell not pearly within, trigonal or ovately rounded, or more or less triangularly ovate ; equivalve. Umbones often eroded ... ... CORBICULIDAE.

Order EULAMELLIBRANCHIATA

Sub-order SCHIZODONTA

Series UNIONACEA

Family UNIONIDAE

The shell is of very variable shape and size, with umbonal sculpture more or less reduced. The hinge is sometimes strongly developed, but sometimes entirely reduced.

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Sub-family UNIONINAE

The shell is nacreous, with a more or less thickened periostracum. The umbones generally bear a corrugated sculpture, concentric, zig-zag or tuberculated. The hinge ligament is somewhat elongated and projecting, with the hinge teeth strongly developed. The pallial line is generally simple. The marsupium is formed by all four gills, or by the outer gills only ; the edge of the marsupium is always sharp and not distending.

Genus **Parreysia** Conard, 1853

The shell is moderately small and usually inflated and varying in shape from ovate to subrhomboid. The umbones are raised, with radial or zig-zag, sometimes moderately extensive sculpture. The left valve bears two irregular pseudocardinals which are sometimes strong and striated and sometimes broken up into denticles ; the right valve bears one, but sometimes two pseudocardinals, the upper being small and compressed and with two laterals. The marsupium is formed by all the four gills.

Parreysia (**Parreysia**) **corrugata** var. **nagpoorensis** (Lea)

Plate XX, figs. 1*a* and 1*b*

Unio nagpoorensis, Lea, Proc. Acad. Nat. Sciences Philadelphia, III, 1859, p. 331.
Unio nagpoorensis, Lea, Journ. Acad. Nat. Sciences Philadelphia, IV, 1860, p. 270 ; pl. 45, fig. 150.
Unio nagpoorensis, Lea, Obs. Genus *Unio*, VII, 1860, p. 88, pl. 45, fig. 150.
Unio nagpoorensis, Blanford, Journ. Asiatic Soc. Bengal, XXXV, 1866, p. 143.
Margaron (*Unio*) *nagpoorensis*, Lea, Sys., 1870, p. 38.
Unio corrugatus, Müller, var. *nagpoorensis*, Hanley & Theobald, Conch. Indica, 1876, p. 21, pl. 45, fig. 3.
Unio corrugatus var. *nagpoorensis*, Theobald, Cat. Shells Brit. India, 1876, p. 47.
Unio corrugatus var. *nagpoorensis*, Paetel, Conch. Sam., 1890, p. 149.
Parreysia corrugata var. *nagpoorensis*, Simpson, Proc. United States National Museum, XXII, 1900, p. 842.
Parreysia corrugata var. *nagpoorensis*, Preston, Rec. Ind. Mus., VII, 1912, p. 298.
Parreysia (*Parreysia*) *corrugata* var. *nagpoorensis*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 157.
Parreysia corrugata var. *nagpoorensis*, Prashad, Rec. Ind. Mus., XV, 1918, pp. 145 and 146.

The shell is inequilateral, transversely ovate and moderately inflated, and may be readily distinguished from that of the next species by the much greater length of the valves in proportion to the height, the valves being nearly twice as long as high. The anterior margin is narrow and rounded while the posterior margin is broader, obliquely truncate and more or less angular above and below. The umbo is prominent and inclined forwards. The surface is covered by a tenacious rufous brown periostracum which becomes more and more greenish brown towards the ventral margin. The surface is smooth except towards the umbo and over the postero-dorsal and antero-dorsal parts of the surface of the valves which are ornamented with somewhat divaricating obliquely radial linear ridges. The hinge margin slopes slightly downwards both in front of and behind the umbo. The dorsal margin in front of the umbo is actually concavely depressed while the ventral margin is almost straight, and only slightly but evenly convex. The lunule is well defined. On the inner surface the pearly layer is slightly tinged pinkish and brilliantly iridescent. The anterior adductor impression is well sunk in a depression and the pallial line is entire. The cardinal teeth are strong, compressed and present a jagged appearance, being markedly crenulated. The laterals are thin, lamellar, elongated and somewhat curved.

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This variety differs from the typical form, *Parreysia* (*Parreysia*) *corrugata* s. str., in the shell being more markedly inequilateral and longer in proportion to the height, and in the periostracum being more or less rufous brown, instead of being greenish or greenish brown.

Recorded localities : Ambajari Tank, Nagpur ; Bengal, Poona, Gudur, Godavari River, and the Madras State, generally. Specimens are reported to have been collected from a stream two miles north of Gudur in Andhra Pradesh. The typical form has been recorded by Annandale (*Rec. Ind. Mus.*, XVI, 1919, p. 151) from Yenna River, Upper Kistna, at Medha.

Specimens in the collection : A single right valve from Gudur, with the periostracum peeled away over the umbo and with the surface layer worn away over portions of the valve. The obliquely radial and divaricating ribbing towards the dorsal margin and around the umbonal area is distinct. The single posterior lateral tooth in this right valve is sharp, slightly arched, thin, lamella-like and elongated. Measurements : Length : 43 mm. ; height : 23 mm. : depth of single valve : 7 mm. These measurements are slightly smaller than those of an average specimen quoted by Preston (*loc. cit.*, 1915, p. 157).

Parreysia (**Parreysia**) **wynegungaënsis** (Lea)

Plate XX, figs. 2*a* and 2*b*

Unio wynegungaënsis, Lea, Proc. Acad. Nat. Sci. Philedelphia, (1859) 1860, p. 331.
Unio wynegungaënsis, Lea, Obs. Genus *Unio*, VII, 1860, p. 89, pl. 45, fig. 151.
Unio wynegungaënsis, Blanford, Journ. Asiatic Soc. Bengal, XXXV, 1866, p. 143.
Unio wynegungaënsis, Sowerby, Conch. Icon., XVI, 1868, *Unio*, pl. 67, p. 339.
Margaron (*Unio*) *wynegungaënsis*, Lea, Syn., 1870, p. 50.
Unio wynegungaënsis, Hanley & Theobald, Conch. Indica, 1876, p. 21, pl. 45, fig. 6.
Unio wynegangensis, Theobald, Cat. Shells Brit. India, 1876, p. 47.
Parreysia (*Parreysia*) *wynegungaënsis* (Lea), Simpson, Proc. United States Nat. Mus., XXII, 1900, p. 842.
Parreysia wynegungaënsis, Ortmann, Ann. Carnegie Mus., VIII, 1911–12, pp. 222–365 ; pls. xviii–xx (anatomy).
Parreysia wynegungaënsis, Preston, Rec. Ind. Mus., VII, 1912, p. 298.
Parreysia (*Parreysia*) *wynegungaënsis*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 157.
Parreysia wynegungaënsis, Prashad, Rec. Ind. Mus., XV, 1918, p. 144.

The shell is inequilateral, broadly elliptical in outline and about one and half times as long as high. The posterior margin is more or less straight, obliquely inclined backwards and somewhat sub-angulate below. The anterior margin is rounded. The umbo is strongly inclined forwards and the hinge margin behind the umbo is almost straight and sloping slightly downwards, terminating in a more or less well defined angle where it meets the posterior margin. The valves bear a rather ill defined keel radiating from the umbo posteriorly towards the ventro-posterior margin. The outer surface of the shell, which is covered by an olive-yellowish brown periostracum, is strongly concentrically striated. The umbonal area is strongly sculptured with radiating zig-zag ribs more or less disposed in the form of arrow-heads, their apices pointing towards the umbo. These ribs are continued as rather coarse and irregular, obliquely radiating striations below the hind hinge margin on the outer surface. The hind upper edge of the shell is tinged dark greenish brown on the outer surface. The surface layer of the shell beneath the periostracal layer is whitish and slightly glossy. The inner surface is beautifully pearly, smooth and iridescent, the pallial line being entire and the anterior adductor impression being lodged in a well marked, deep, ovate depression, while the posterior adductor impression is not appreciably depressed. The hinge teeth are typical, and disposed as stated in the generic description above.

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Recorded localities : Wynegunga River, Bengal ; 30 miles east of Nagpur, in the Deccan ; Ortali River, Damuda, Surat, Sambalpur, Godavary River, Barod, about 130 miles south-west of Sepree, and Assam.

Specimens in the collection : A single left valve from the Godavary River. In the present specimen, the two pseudocardinals are distinct and strongly developed, but irregular and broken up into denticles. There are two thin, lamina-like, elongated, posterior lateral teeth, almost parallel to each other, with a deep linear groove in between them. Measurements : Length : 36 mm. ; height : 26 mm. ; depth (of the single valve) : 10 mm. Compared with the measurements of the three average specimens of this species in the British Museum quoted by Preston (*loc. cit.*) the present specimen is considerably smaller, and is apparently not a full-grown shell.

Genus **Lamellidens** Simpson, 1900

The shell is elongate, elliptical, and narrowed behind, with a slight post-dorsal expansion and a low, biangulate posterior ridge. The umbones bear curved radiating ridges which sometimes zig-zag and often become almost concentric, but are obsolete towards the centre. The periostracum is smooth, shining, brownish, often with concentric bands of lighter colour and practically devoid of rays. The left valve bears two compressed psuedocardinals, the front one being roughened, and two laterals. The right valve bears two parallel lamellar pseudocardinals and one lateral. The umbonal cavities are rather shallow. The pearly layer is well developed and varies in colour from a bluish white to a pale straw-yellow. The marsupium is formed by the outer pair of gills only.

Lamellidens marginalis (Lamarck)

Plate XX, figs. 3*a* and 3*b*

Unio marginalis, Lamarck, Anim. sans vert., VI, 1819, p. 79.
Unio marginalis, Deshayes, Encyclopédie Méthodique, II, 1827, p. 151 ; pl. 247, fig. 1.
Unio marginalis, Catlow & Reeve, Conch. Nomencl., 1845, p. 61.
Unio marginalis, Adams, H, & A., Genera of Recent Mollusca, II, 1857, p. 491.
Unio marginalis, Sowerby, in Reeve, Conch. Icon., XVI, 1867, pl. 59, fig. 297.
Unio marginalis, Hanley & Theobald, Conch. Indica, 1876, p. 20 ; pl. 43, fig. 2.
Unio marginalis, Theobald, Cat. Shells Brit. India, 1876, p. 46.
Margarita (*Unio*) *marginalis*, Lea, Syn., 1836, p. 37 ; 1838, p. 24.
Margaron (*Unio*) *marginalis*, Lea, Syn., 1852, p. 38 ; 1838, p. 24.
Unio anodontina, Lamarck, Anim. sans vert., VI, 1819, p. 80.
Unio anodontina, Deshayes, Anim. sans vert., VI, 1835, p. 546 ; ii, 1839, p. 671.
Symphonata bilineata, Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 98, pl. 2, fig. 19.
Margarita (*Unio*) *bilineatus*, Lea, Syn., 1836, p. 38 ; 1838, p. 25.
Unio bilineatus, Catlow & Reeve, Conch. Nomencl., 1845, p. 56.
Unio bilineatus, Sowerby, in Reeve, Conch. Icon., XVI, 1868, pl. 71, fig. 365.
Margaron (*Unio*) *bilineatus*, Lea, Syn., 1852, p. 38 ; 1870, p. 61.
Lamellidens marginalis, Simpson, Proc. United States Nat. Mus., XXII, 1900, pp. 854–855.
Unio marginalis, Ramanan, Non-marine Mollusca of Madras and its vicinity, 1900, p. 66.
Lamellidens marginalis, Preston, Rec. Ind. Mus., VII, 1912, pp. 302 and 304.
Lamellidens marginalis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 175.
Lamellidens marginalis, Ghosh, Rec. Ind. Mus., XV, 1918, pp. 109–122 (Anatomy).
Lamellidens marginalis, Prashad, Rec. Ind. Mus., XV, 1918, pp. 143–146 (Anatomy, especially Glochidium).
Lamellidens marginalis, Annandale, Rec. Ind. Mus., XVI, 1919, pp. 139 and 151.
Lamellidens marginalis, Prashad, Rec. Ind. Mus., XVI, 1919, p. 293 ; text-fig. 4 (animal).
Lamellidens marginalis, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1919, pp. 19–21 ; 57 and 59.
Lamellidens marginalis, Prashad, Rec. Ind. Mus., XIX, 1920, pp. 168–170, 172.
Lamellidens marginalis, Prashad, Rec. Ind. Mus., XXIV, 1922, p. 106.

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This is the common Indian Freshwater Mussel, generally used for dissection in our laboratories. Living specimens of this species are found abundantly in all freshwater ponds and rivers. They frequent both running and stagnant waters.

The shell is transversely oblong-ovate, nearly twice as long as high, rather thin for its size, smooth and glossy, somewhat inflated, and covered with a blackish brown or greenish brown periostracum which is frequently found eroded and worn away in the region around the umbones, particularly in adult shells. The inner surface of the valves is pearly and iridescent, sometimes bearing small pearly granules. The shell is inequilateral, the umbo being placed much nearer the anterior end. The dorsal margin behind the umbo is almost straight and extends as a more or less well defined wing-like expansion. The point where the dorsal margin meets the posterior margin is more or less angular. The posterior margin slopes obliquely downwards from this point, and is somewhat angular below where it rounds off into the ventral margin which is evenly curved. The anterior margin is narrower than the posterior, and is evenly rounded. The dorsal margin in front of the umbo is short and slopes steeply downwards. The adductor impressions and the non-sinuate pallial line are typical. The hinge teeth are disposed as stated in the generic description above. Strong, concentric growth striae are conspicuous throughout the surface of the valves. Young shells are thinner and tend to be more greenish brown and paler than the thicker adult shells which are generally darker and more blackish brown. There is a low, posterior biangulate keel-like ridge or rather, elevation, running obliquely, posteriorly from the umbo down to the postero-ventral margin of the shell. Most shells have a narrow pale band on the outer surface round the margin.

As this species is extremely common and is frequently used as a type for the study of the soft parts of Lamellibranchs in general, a brief description of the animal is appended below :

The body is pale greyish, the mantle being edged with a pale greyish brown or blackish border. The margin of the mantle is entire and slightly thickened beyond the pallial connection. The foot is elongate, tongue-shaped, moderately large and of a milky grey colour. The gills are much broader in the posterior than in the anterior half of their length, and the inner pair is broader than the outer throughout. Only the outer pair of gills are marsupial, the entire length of the gills being filled up with glochidia in mature individuals. The branchial aperture is rather large, with two or three rows of well developed pointed papillae, and is of a brownish colour. The siphons are simple. The anal aperture is much smaller than the branchial and has a row of small papillae along the margin.

The animals are ovo-viviparous and are prolific breeders ; they breed from September to February. A mussel may contain nearly 200 to 250 embryos in its brood chamber. The glochidia leave the parent mussel within a month or two. The animals are inactive, burying themselves obliquely head downwards in the mud at the bottom of streams and ponds, with the open, siphonal orifices projecting above the level of the mud.

Recorded localities : This species is very widely distributed throughout India, Burma and Ceylon. A long list of localities of specimens of this species in the Indian Museum is quoted by Preston (*Rec. Ind. Mus.*, VII, 1912, p. 303). Several varieties and subspecies of this species have

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been described, only one among them, namely, *L. marginalis* subsp. *corrianus* (Lea) from Madras, being represented in the Museum collection, but this is now regarded as a distinct species and is hence described as such in the present paper.

Specimens in the collection : Numerous shells of all sizes and stages of growth are contained in the collection. In most specimens the surface layers are worn away over and around the umbonal areas, exposing the nacreous layer. Young shells are very thin and semi-translucent, and as a rule more highly glossy on the outer surface. Some shells are of a beautiful, glossy, dark chestnut-brown colour. Measurements : (of an average adult shell) : Length : 81 mm. ; height : 44 mm. ; depth of single valve : 14 mm. ; (of an average young shell) : Length : 36 mm. ; height : 19 mm. ; depth of single valve : 6 mm. Between these two extremes, there are specimens in the collection of all intermediate stages.

Lamellidens corrianus (Lea)

Plate XX, figs. 4*a* and 4*b*

Unio corrianus, Lea, Trans. Amer. Phil. Soc., V, ser. 2, 1834, p. 65, pl. 9, fig. 25.
Unio corrianus, Lea, Obs. Genus *Unio*, I, 1834, p. 177 ; pl. 9, fig. 25.
Unio corrianus, Hanley, Cat. Bivalve Shells, 1843, p. 207 ; pl. 20, fig. 60.
Unio corrianus, Catlow & Reeve, Conch. Nomencl., 1845, p. 57.
Unio corrianus, Adams, H. & A., Genera of Recent Mollusca, II, 1857, p. 491.
Unio marginalis var. *Corriana*, Hanley & Theobald, Conch. Indica, 1876, p. 20 ; pl. 44, fig. 4.
Unio marginalis race *Corrianus*, Theobald, Cat. Shells Brit. India, 1876, p. 46.
Margarita (*Unio*) *corrianus*, Lea, Syn., 1836, p. 38 ; 1838, p. 25.
Margaron (*Unio*) *corrianus*, Lea, Syn., 1852, p. 38 ; 1879, p. 61.
Unio corrianus, *dolichorhynchus* and *protensus*, Tapparone-Canefri, Ann. Mus. Civ. St. Nat. Genova, VII, 1889, p. 349.
Lamellidens corrianus, Simpson, Proc. United States Nat. Mus., XXII, 1900, p. 857.
Lamellidens canefrinus, Simpson, ibid., p. 857.
Lamellidens marginalis var. *corrianus*, Preston, Rec. Ind. Mus., VII, 1912, p. 304.
Lamellidens canefrinus, Simpson, Descr. Cat. Naiades, 1914, p. 1176.
Lamellidens marginalis subsp. *corrianus* and *L. canefrianus*, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, pp. 183 and 187.
Lamellidens marginalis var. *corrianus*, Annandale & Prashad, Rec. Ind. Mus., XVIII, 1919, p. 59.
Lamellidens corrianus, Annandale & Prashad, Rec. Ind. Mus., XXII, 1921, p. 609.
Lamellidens corrianus, Prashad, Rec. Ind. Mus., XXIV, 1922, p. 106.

The shell is strongly inequilateral, and is readily distinguished from that of the preceding species by its being more narrowly ovate, more strongly transverse and longer in proportion to its height (being almost exactly twice as long as high), by the valves being much thinner, by the umbones being much less prominent, by the upper margins being straighter and by the absence of the light border along the margins. In these latter respects it approaches more closely the shell of the subspecies *rhadinaeus* (Annandale and Prashad, *loc. cit.*, p. 59). The anterior margin of the shell is rounded, while its posterior margin is more or less sub-angular. The ventral margin is evenly curved. The cardinal teeth are thin and lamina-like, single in the left valve and double in the right, while the lateral teeth are elongated, thin and very nearly straight. The outer surface is dark greyish brown, with two distinct diverging radial lines passing obliquely behind from the umbo to the hind margin, below the thin, wing-like post-dorsal expansion. The shells generally have the periostracal layer worn away over and around the umbones. The nacreous

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layer on the inner surface is pearly white and iridescent. The umbones are only very slightly elevated and are minutely waved at the tip. The cavity of the umbones is very shallow. The cardinal teeth of this species differ from those of the preceding one in being unusually thin and nearly parallel to the lateral teeth. There are two pseudocardinals in the right valve, the upper of the two being rather small and thin ; in the left valve also the two pseudocardinals are distinct, but the upper and posterior one is feebly developed. There are two lateral teeth in the left valve and one in the right ; they are only slightly arched.

This species is closely related to the preceding one and has been variously treated as a subspecies, variety and race of the latter by Preston, Hanley and Theobald, but subsequently Annandale and Prashad (*loc. cit.*, 1921) have confirmed its status as a separate species as many of its characters are specifically distinct.

Recorded localities : Calcutta, Sibsagar, Assam, Pegu ; Balagunge, Central Sylhet, Burma, Zayleyman, Upper Burma ; Madras, Berhampur, Murshidabad District, West Bengal, Sambalpur, Manipur Valley (Loktak Lake).

Specimens in the collection : One dry-preserved shell with both the valves intact, from Madras, and another larger spirit-preserved specimen with the soft parts *in situ* from Trivandrum. The surface is dull greyish brown, rather faded over the middle part in the Madras shell, but dark, almost blackish brown in the specimen from Trivandrum which is in a much fresher condition. Measurements (of the Madras shell) : Length : 51 mm. ; height : 26 mm. ; depth of single valve : 9 mm. ; (of the shell from Trivandrum) : Length : 68 mm. ; height : 34 mm. ; depth of both valves together : 25 mm.

Sub-order HETERODONTA

SERIES SPHAERIACEA

Family CORBICULIDAE

The shell is more or less large and thick, triangular or ovate, with the outer surface concentrically striated, and with yellowish, greenish or brownish periostracum. The hinge margin is well developed, usually with three diverging cardinal teeth beneath the umbo, and with both anterior and posterior lateral teeth. The ligament is external and the pallial line usually bears a sinus. This family includes the freshwater clams, found commonly in lakes, ponds and estuaries.

This family corresponds to the family Cyrenidae of Lankester, which is the family name also used by Preston in his volume on the Freshwater Gastropoda and Pelecypoda in the Fauna of British India series (1915), to include the genara *Villorita* and *Corbicula*. Thiele, however, adopts the name Corbiculidae for this family, the generic name *Cyrena* being cited as a synonym for *Corbicula* s. str. in his *Handbuch der systematischen Weichtierkunde*, II, 1935.

Two genera, *Villorita* and *Corbicula* are represented in the Museum collection. In the former, the shell is solid, thick and triangularly and somewhat obliquely ovate, being rather inequilateral, with the posterior margin more or less markedly produced, and of the three cardinal teeth, the

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anterior in the right valve and the posterior in the left are obsolete ; while in the latter, the shell is thinner, less solid, more regularly trigonal and ovate, being much less strongly inequilateral, and the three cardinal teeth are more or less equally developed in both the valves.

Genus **Villorita** Griffith & Pidgeon, 1834
(Syn. **Velorita** Gray, 1847)

The shell is moderately large, thick, obliquely triangular, the hind margin being flattened and angular below. The umbones are prominent and well elevated. The hinge margin is very short and thick, always with three oblique cardinal teeth, of which the anterior in the right valve and the posterior in the left valve are obsolete. The anterior right lateral tooth is very short and situated close to the hinge margin. The posterior laterals are elongated and diverging. The pallial sinus is very small.[1]

A single species, *V. cyprinoides*, and one of its varieties, *V. cyprinoides* var. *cochinensis*, are represented in the Museum collection. In the typical form, *V. cyprinoides* s. str., the shell is much larger, thicker and more strongly inflated, and the umbones are situated more anteriorly than in the variety *cochinensis*. Preston and other earlier authors treated these two as distinct species, but I have followed Prashad (*Rec. Ind. Mus.*, XXII, 1921, p. 116) in regarding the latter as a variety, as there are no major distinguishing features to warrant specific separation.

Villorita cyprinoides (Gray)

Plate XXI, figs. 1*a* and 1*b*

Cyrena cyprinoides, Gray, Ann. Phil., n. ser., IX, 1825, p. 136.
Venus cyprinoides, Wood, Index Test., Suppl., 1828, pl. 2, fig. 14.
Villorita cyprinoides, Griffith & Pidgeon, Animal Kingdom, XII, 1834, pl. 31, fig. 5.
Velorita cyprinoides, Deshayes, Cat. Brit. Mus. Conchifera, 1854, pp. 240–241.
Velorita cyprinoides, Prime, Cat. Corbiculidae, in Amer. Journ. Conch., V, 1869–70, p. 141, No. 2.
Velorita cyprinoides, Theobald, Cat. Shells Brit. India, 1876, p. 44.
Velorita cyprinoides, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Velorita*, pl. 1, figs. 1*a–c*.
Velorita cyprinoides, Clessin, in Martini-Chemnitz, Conch. Cab., 1879, pp. 224–295 ; pl. 42, figs. 3 and 4.
Velorita cyprinoides, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 209.
Villorita cyprinoides, Prashad, Rec. Ind. Mus., XXII, 1921, p. 114.

The shell is fairly large, and very thick, somewhat ovately triangular, heart-shaped, strongly oblique and inflated over the umbonal and central portions of the valves. The umbones are situated near the anterior margin and are strongly recurved anteriorly and somewhat inwards, being closely approximated towards each other. The anterior margin is short, evenly curved above, almost straight in the middle and rapidly curving backwards below, and continued into the ventral border which curves upwards posteriorly to meet the posterior margin in a more or less angular or narrowly rounded corner. The posterior margin is nearly straight and obliquely

[1] For a detailed description of the genus *Villorita* and its Indian species and varieties, the reader is referred to Prashad, *Rec. Ind. Mus.*, XXII, 1921, pp. 111–119, where a new species, *V. cornucopia* from Travancore has also been described, distinguished by its shell being much higher than broad and by its umbones being very prominent and recurved.

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sloping, much longer than the anterior border and bears a low keel. The surface is traversed throughout by strong, concentric ridges which are more strongly developed in the anterior half of the shell than towards the posterior border. The umbones are also striated, but are often found in a worn condition. The lunule in front of the umbo is narrow, and the ligament large and external. The periostracum is dark olive-brown or blackish brown, sometimes entirely blackish, while the nacreous layer on the inside is whitish, light yellow near the margin with a violet tinge at the border. The hinge teeth are well developed and disposed as stated in the generic description above. A detailed description of the soft parts of this species is given by Prashad (*loc. cit.*, p. 115).

Recorded localities : This species is confined to Peninsular India and to the Malabar Coast only, where it occurs in brackish water localities. It has been recorded from near Beypur. Preston quotes measurements of authentic shells of this species in the British Museum collection from the Malabar Coast (*loc. cit.*).

Specimens in the collection : A single, large dry-preserved shell, with both the valves intact, from Alleppey is contained in the late Mr. Crichton's collections donated to the Madras Museum. The periostracum is blackish and worn away over portions of the surface, including the umbones. Measurements : Length : 50 mm. ; height : 47 mm. ; depth of both valves together : 34 mm. These are considerably larger than the average measurements quoted by Preston (*loc. cit.*).

Villorita cyprinoides var. **cochinensis** (Hanley)

Plate XXI, figs. 2*a* and 2*b*

Cyrena cochinensis, Hanely, Proc. Zool. Soc. London, XXVI, 1858, p. 543.
Cyrena corbiculiformis, Prime, Proc. Acad. Nat. Sciences Philadelphia, 1860, p. 80.
Cyrena corbiculoides, Prime, Cat. Corbiculidae, 1863, p. 6.
Corbicula Quilonica, Benson, Ann. & Mag. Nat. Hist., 3rd ser., VI, 1860, p. 260.
Velorita cochinensis, Hanley, Ann. Lyc. Nat. Hist. Soc., New York, VII, 1866, p. 236, fig. 66.
Velorita cochinensis, Prime, Cat. Corbiculidae, in Amer. Journ. Conch., V, 1869–70, p. 141, No. 1.
Velorita cochinensis, Sowerby, in Reeve, Conch. Icon., XX, 1878, *Velorita*, pl. 1, figs. 2*a* and 2*b*.
Velorita Kochinensis, Theobald, Cat. Shells Brit. India, 1876, p. 44.
Velorita cochinensis, Clessin, in Martini-Chemnitz, Conch. Cab., 1879, p. 225 ; pl. 36, figs. 5 and 6.
Velorita cochinensis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 210.
Villorita cyprinoides var. *cochinensis*, Prashad, Rec. Ind. Mus., XXII, 1921, p. 116.

The shell is thick, solid, cordate, almost as high as broad, and rather inequilateral and oblique, but the umbo is more centrally situated and less obliquely inclined than in the typical form. The valves are more or less inflated, and the surface, which is covered by a blackish brown periostracum, is regularly and concentrically striated. These ridges are more markedly developed than in the typical form over the front and dorsal portions of the surface, but become quite obsolete towards the posterior and ventral margins. The anterior margin is regularly curved, but is much shorter than in the typical form. The lunules are greatly reduced. The posterior margin is rather straight, obliquely sloping, and more or less narrowly and angularly rounded below where it joins the evenly curved ventral margin. The dorsal area behind the umbones is wide and bears the strong external ligament. The outer surface is generally glossy and deep reddish brown or blackish brown. The nacreous layer on the inner surface is whitish, but the region

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outside the pallial line is fleshy pink and the extreme margin is smoky brown. The surface layer below the periostracum is reddish purple. The cardinal teeth tend to shelve outwards. The hinder and central ones bear a shallow, linear grooving which makes them appear incompletely bifid. The front one in the right valve is very short and pyramidal. The umbones are sharper in young specimens. The periostracum is generally found slightly worn away over and around the umbonal areas.

Recorded localities : Cochin ; Malabar Coast ; Beypore ; south end of Vembanad Lake, Travancore, and from various backwaters in Travancore. The geographical range of this variety is more or less the same as that of the typical form. Preston cites measurements of three shells from the Malabar Coast in the British Museum collection, but their exact locality is not known (*loc. cit.*).

Specimens in the collection : A single left valve from Travancore in the exhibited gallery collection of the Museum, rather reddish brown, and with the periostracum worn away over portions of the surface, and two entire shells with both valves intact and a blackish brown periostracum from the late Mr. Crichton's collections donated to the Museum ; of these two latter specimens, one is from Mangalore and the other from Cochin. In addition to these, there is among Mr. Crichton's shells, a much smaller, probably young shell, with very highly polished, dark snuff-brown surface, with regular, close-set concentric striations more or less well developed over the greater part of the surface, labelled " *Villorita* sp." from Cochin, but it seems almost certainly referable to the present variety, although apparently it is only a half-grown shell. The periostracum is intact over the entire surface in this specimen, and it is quite likely that it was collected in the living condition, but the fleshy pink tint on the inner surface of the valves is absent. Measurements (of the adult shell from Cochin, in Mr. Crichton's collection) : Length : 30 mm. ; height : 29 mm. ; depth of both valves together : 18 mm. These measurements are slightly smaller than those of the Malabar Coast specimens cited by Preston (*loc. cit.*).

Genus **Corbicula** Megerle von Muhlfeld, 1811

The shell is usually moderately small, rounded or ovate, slightly inequilateral with the umbo more or less prominent. The hinge margin is moderately broad, always bearing three diverging cardinal teeth in each valve. The anterior and posterior lateral teeth are elongated, compressed, lamelliform and finely striated. The right valve bears two lateral teeth both anteriorly and posteriorly, while the left valve has only one lateral tooth on each side. The pallial line is usually non-sinuate. The edge of the mantle bears small conical tentacles.

The shells are much more regularly ovate, much less strongly inequilateral, and thinner than in *Villorita*.

Several Indian species of the genus *Corbicula* are known, of which three, *viz.*, *C. striatella*, *C. occidens* and *C. regularis* are represented in the Museum collection, but only by dry shells. They differ very little in external appearance, shape and colour.

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Corbicula striatella Deshayes

Plate XXI, figs. 3*a* and 3*b*

Corbicula striatella, Deshayes, Proc. Zool. Soc. London, XXII, 1854, p. 344.
Corbicula striatella, Deshayes, Cat. Brit. Mus. Conchifera, 1854, p. 224.
Corbicula striatella, Prime, Ann. Lyc. Nat. Hist. Soc., New York, VII, 1867, p. 74, fig. 22.
Corbicula striatella, Hanley & Theobald, Conch. Indica, 1876, p. 55 ; pl. 138, figs. 7 and 10.
Corbicula striatella, Clessin, in Martini-Chemnitz, Conch. Cab., 1879, p. 167, No. 58 ; pl. 29, figs. 19 and 20 ; pl. 30, fig. 20.
Corbicula striatella, Theobald, Cat. Shells Brit. India, 1876, p. 45.
Corbicula violacea, Prime, Proc. Acad. Nat. Sciences, Philadelphia, 1861, p. 128.
Corbicula striatella, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 214.
Corbicula striatella, Annandale, Rec. Ind. Mus., XXII, 1921, p. 163.
Corbicula striatella, Rao, H.S., Rec. Ind. Mus., XXX, 1921, p. 464.

The shell is triangularly ovate, very slightly inequilateral, the anterior side being slightly longer than the posterior. The posterior margin slopes steeply down from the umbo and is somewhat truncated below before joining the evenly curved ventral margin. The margin in front of the umbo slopes down more gradually, leading on to the broadly rounded anterior margin. The surface is regularly and closely concentrically striated, the striae on the umbonal regions being much finer. The umbones are rather sharp, prominent and slightly glossy. The outer surface of the valves is covered by a pale greenish brown periostracum. The interior of the valves is dark violet, and rather darker in the region outside the pallial line. The three diverging cardinal teeth are strongly developed, but rather unequal, the hind one in the left valve being smaller and thinner. The lateral teeth are elongated, plate-like, and finely transversely striated throughout. The pallial sinus is more clearly marked in this species than in the succeeding one, though it is only very slightly indented. Towards the anterior and posterior margins of the valves on the outer surface there are indications of dark, diverging radial bands running down from the umbo. Living specimens of this species are generally found at the bottom of muddy and sluggish streams.

Recorded localities : This species is fairly common all over India, and is not confined to Pondicherry and Sind as stated by Preston (*loc. cit.*, p. 215). Annandale records it from a small stream near Waikhong on the Manipur—Burma Road. It is also recorded from the Northern Shan States, particularly in the valleys of the Namtu and Nam Pang Rivers. This species has a wide range of distribution in India as well as in Burma.

Specimens in the collection : One dry-preserved shell with both valves intact, labelled " South India ", but the exact locality from which it was collected is not known. Measurements : Length : 23 mm. ; height : 21 mm. ; diameter (of both valves together) : 15 mm. The specimen is larger than the biggest of the British Museum specimens (from Sind) the measurements of which are cited by Preston (*loc. cit.*, p. 215).

Corbicula occidens Deshayes

Plate XXI, figs. 4*a* and 4*b*

Corbicula occidens, Deshayes, Cat. Brit. Mus. Conchifera, 1854, p. 223.
Corbicula occidens, Prime, Ann. Lyc. Nat. Hist. Soc., New York, VIII, 1866, p. 220, fig. 51.
Corbicula occidens, Hanley & Theobald, Conch. Indica, 1876, p. 55 ; pl. 138, figs. 8 and 9.
Corbicula occidens, Theobald, Cat. Shells Brit. India, 1876, p. 45.
Corbicula occidens, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 216.
Corbicula occidens, Annandale, Rec. Ind. Mus., XXII, 1921, p. 612.

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The shell is moderately small, triangularly ovate, almost equilateral, rather inflated, and with the surface regularly and closely concentrically striated throughout. The outline of the shell is more regularly ovate than in the preceding species, and the margins in front of and behind the umbo slope more or less at equal angles. The anterior and posterior margins of the shell are almost equally broad and rounded, and the ventral margin evenly curved. The surface is covered with a greenish brown periostracum and the umbones bear a dark violet radially widening coloured band medially. In addition to this there are two narrow dark bands diverging radially from the umbo, one in front of, and the other behind, the broad medial band. The umbones are prominent and fairly inflated. The lunule is elongately ovate and pale coloured. The interior of the valves is dark purplish brown, the colour being much darker than in the preceding species. The hinge bears three diverging cardinal teeth somewhat unequally developed, the front one on the right valve being rather small and thin. The lateral teeth are thin, elongated, whitish and finely striated. The pallial sinus is much less strongly marked than in the preceding species. The pallial line is slightly discontinuous, first running down vertically from the posterior adductor impression and then bending rather sharply forwards at a little more than a right angle whence it runs forwards up to the anterior adductor impression.

Recorded localities : Sikkim, Moradabad and Bengal are the original localities cited by Preston for this species, but Annandale records specimens of this species in the Indian Museum collection from various other localities such as Central Provinces, Bihar, Orissa and Assam.

Specimens in the collection : One dry-preserved shell with both valves intact, from Cochin, a locality from which this species has not been previously recorded. Measurements : Length : 20 mm. ; height : 17 mm. ; diameter (of both valves together) : 10 mm. This specimen is considerably larger than the three British Museum shells, the measurements of which have been cited by Preston (*loc. cit.*, p. 216).

Corbicula regularis Prime

Plate XXI, figs. 5*a* and 5*b*

Corbicula regularis, Prime, Proc. Zool. Soc. London, XXVIII, 1860, pp. 321–322.
Corbicula regularis, Prime, Cat. Corbiculidae, in Amer. Journ. Conch., V, 1869–70, p. 136, No. 90.
Corbicula regularis, Hanley & Theobald, Conch. Indica, 1876, p. 55 ; pl. 138, figs. 5 and 6.
Corbicula regularis, Clessin, in Martini-Chemnitz, Conch. Cab., 1879, p. 202.
Corbicula regularis, Preston, Fauna Brit. India, Mollusca, Gastropoda & Pelecypoda (Freshwater), 1915, p. 217.

The shell is triangularly ovate, somewhat higher in proportion to its width than in the two preceding species, and equilateral. The margins in front of and behind the umbo slope rather steeply down, and at equal angles. The anterior and posterior margins are almost equally broad and rounded, and the ventral margin evenly curved. The outer surface is strongly and regularly concentrically striated. The periostracum is greenish brown, rather darker towards the posterior margin. The umbonal areas are marked by a dark purplish radially widening band. The interior of the valves is violet and glossy. The three diverging cardinal teeth are well developed, and the laterals are elongated, somewhat arched and finely transversely striated. The pallial sinus, though shallow, is more distinctly marked than in the two preceding species.

Recorded localities : Deccan, Madras.

Specimens in the collection : A single dry-preserved shell with both valves intact, labelled "South India". Its exact locality is not known. Measurements : Length : 21 mm. ; height : 18 mm. ; diameter (of both valves together) : 12 mm.

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REFERENCES TO LITERATURE ON LAND AND FRESHWATER MOLLUSCA

NOTE:—The following list includes most of the better-known standard works on the subject, as well as a selection of some of the more important papers appearing in various periodical publications and referred to in the present volume. For other references, the reader is referred to the list of references and synonyms prefixed to the systematic descriptions of the various species recorded in this paper. Further references may also be traced from the bibliographies appended to some of the works cited in this list.

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APPENDIX

LIST OF NEW RECORDS REPORTED IN THIS PAPER

The following is a list of species, specimens of which in the Madras Museum Collection are from localities from which these species have not been hitherto specifically recorded :—

	Name of Species	Page	Locality
1.	*Theobaldius ravidus* (Benson)	14	Thirupathi Hills, Chittoor District.
2.	*Cyclophorus (Litostylus) nilagiricus* (Benson) ...	16	Mudgiri, Mysore.
3.	*Cyclophorus (Litostylus) involvulus* (Müller) ...	17	Midnapore, W. Bengal.
4.	*Pterocyclus nanus* (Benson)	23	Mudgiri, Mysore.
5.	*Vivipara bengalensis* (Lamarck)	31	Cocanada and Bangalore.
6.	*Vivipara dissimilis* (Müller)	33	Mudgiri, Mysore.
7.	*Mainwaringia paludomoidea* (Nevill) ...	37	Ennur, Chingleput District.
8.	*Faunus ater* (Linné)	47	Vizagapatam and Cocanada.
9.	*Lymnaea pinguis* Dohrn	59	Horsleykonda, Chittoor District.
10.	*Anisus (Gyraulus) convexiusculus* (Hutton) ...	65	Madras.
11.	*Anisus (Gyraulus) saigonensis* (Crosse & Fischer)	66	Bangalore.
12.	*Rachis bengalensis* (Lamarck)	71	Barkuda Island, Orissa.
13.	*Rachis praetermissus* (Blanford)	72	Nellore District.
14.	*Cerastus malabaricus* (Pfeiffer)	75	Malabar.
15.	*Cerastus jerdoni* (Reeve)	76	Malabar.
16.	*Glessula tenuispira* (Benson)	80	Shevroy Hills.
17.	*Zootecus chion* (Pfeiffer)	86	Coimbatore.
18.	*Macrochlamys aulopsis* (Benson)	100	Nilgiris.
19.	*Macrochlamys lixa* (Blanford)	101	Pamban, Gulf of Manaar.
20.	*Macrochlamys vilipensa* (Benson)	102	Shevroy Hills.
21.	*Euplecta layardi* (Pfeiffer)	105	Anamalais.
22.	*Euplecta subdecussata* (Pfeiffer)	106	Pamban, Gulf of Manaar.
23.	*Euplecta acuducta* (Benson)	112	Horsleykonda, Chittoor District.
24.	*Euplecta hyphasma* (Pfeiffer)	113	Kalakkad Forest, Tinnevelly District.
25.	*Euplecta* sp. near *sisparica* (Blanford) ...	113	Pulney Hills.
26.	*Cryptozona (Nilgiria) maderaspatana* (Gray) ...	124	Pulney Hills.
27.	*Mariaella beddomei* (Godwin-Austen) ...	131	Pulney Hills.
28.	*Acavus haemastoma* (Linné)	132	Sivaganga.
29.	*Corbicula occidens* Deshayes	153	Cochin.

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PLATES

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NOTE:—All the illustrations are drawn to natural size, except where otherwise stated ; where figures are drawn enlarged, the extent of the magnification is indicated in the explanations of the corresponding figures.

PLATE I

Fig. 1*a*. *Theobaldius bairdi* (Pfeiffer), (upper side).
,, 1*b*. ,, ,, ,, (lower side).
,, 2*a*. *Theobaldius ravidus* (Benson), (upper side).
,, 2*b*. ,, ,, ,, (lower side).
,, 3*a*. *Theobaldius stenostoma* (Sowerby), (upper side).
,, 3*b*. ,, ,, ,, (lower side).
,, 4*a*. *Cyclophorus* (*Litostylus*) *nilagiricus* (Benson), (side view).
,, 4*b*. ,, ,, ,, ,, (upper side).
,, 4*c*. ,, ,, ,, ,, (lower side).
,, 5*a*. *Cyclophorus* (*Litostylus*) *involvulus* (Müller), (side view).
,, 5*b*. ,, ,, ,, ,, (upper side).
,, 5*c*. ,, ,, ,, ,, (lower side).
,, 6*a*. *Cyclophorus* (*Litostylus*) *ceylanicus* (Pfeiffer), (side view).
,, 6*b*. ,, ,, ,, ,, (upper side).
,, 6*c*. ,, ,, ,, ,, (lower side).
,, 6*d*. ,, ,, ,, ,, (operculum).

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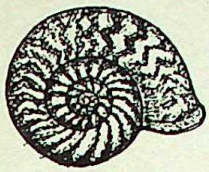

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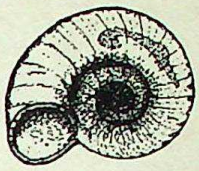

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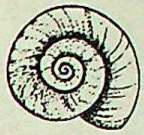
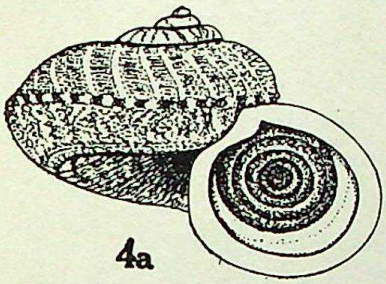


2a

2b

3a



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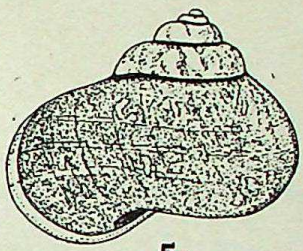
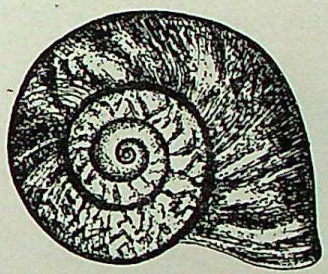


5a

3b



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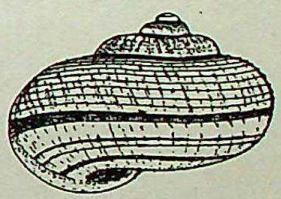
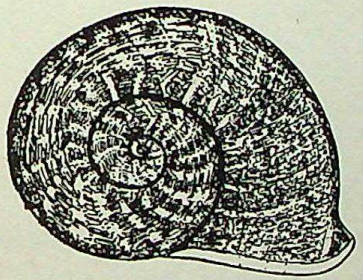


6a



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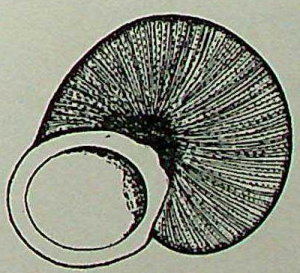

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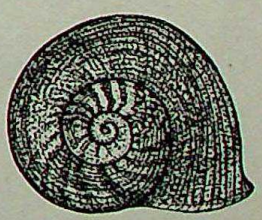
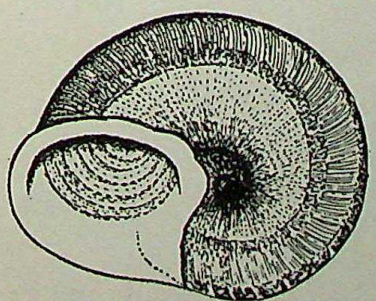


6b



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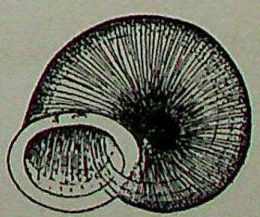

6c

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PLATE II

Fig. 1*a*. *Cyclophorus* (*Annularia*) *aurantiacus* (Schumacher), (side view).
,, 1*b*. ,, ,, ,, ,, (upper side).
,, 1*c*. ,, ,, ,, ,, (lower side)
,, 2*a*. *Aulopoma helicinum* (Chemnitz), (upper side).
,, 2*b*. ,, ,, ,, (lower side).
,, 2*c*. ,, ,, ,, (operculum).
,, 3*a*. *Aulopoma itieri* (Guérin), (upper side).
,, 3*b*. ,, ,, ,, (lower side).
,, 4*a*. *Aulopoma grande* (Pfeiffer), (upper side).
,, 4*b*. ,, ,, ,, (lower side).
,, 4*c*. ,, ,, ,, (operculum).
,, 5*a*. *Pterocyclus bilabiatus* (Sowerby), (upper side).
,, 5*b*. ,, ,, ,, (lower side).
,, 6*a*. *Pterocyclus nanus* (Benson), (upper side).
,, 6*b*. ,, ,, ,, (lower side).
,, 7*a*. *Pterocyclus comatus* Möllendorff, (upper side).
,, 7*b*. ,, ,, ,, (lower side).
,, 8. *Cyathopoma filocinctum* (Benson), (×4).

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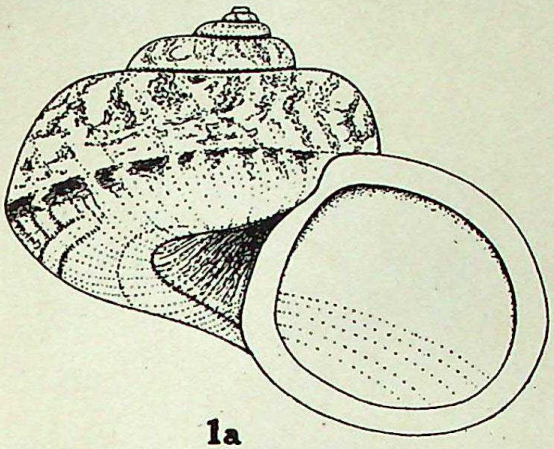
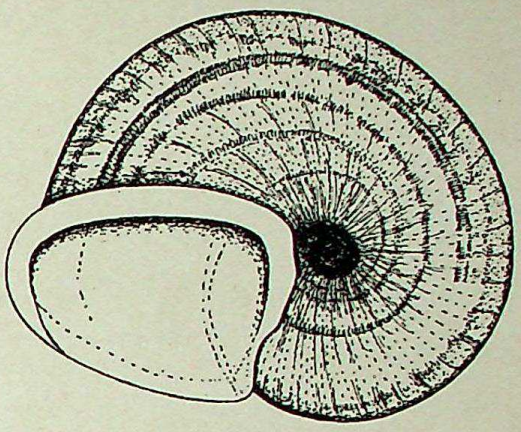


1a



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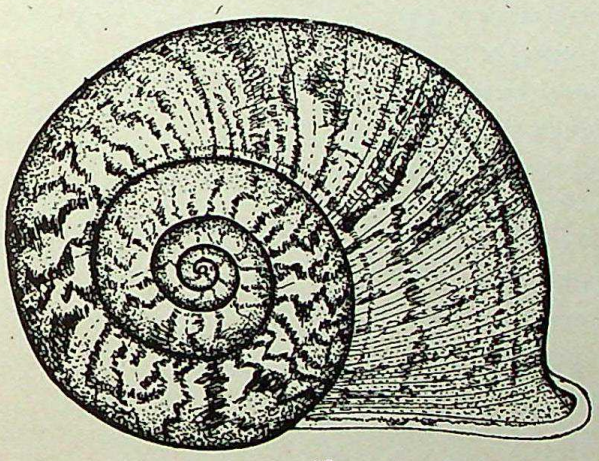
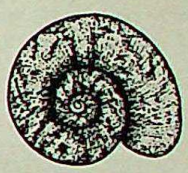


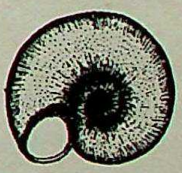
1b

2a



3a

2b



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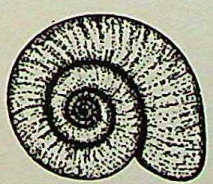
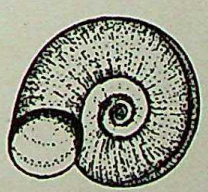


4a



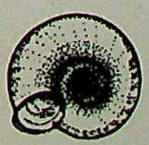
4b

4c

5a

5b

6a



6b

7a

7b

8

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PLATE III

Fig. 1*a*. *Tortulosa cumingi* (Pfeiffer), (outer view, ×2).
,, 1*b*. ,, ,, ,, (apertural view, ×2).
,, 2*a*. *Tortulosa nietneri* (Nevill), (outer view, ×2).
,, 2*b*. ,, ,, ,, (apertural view, ×2).
,, 3*a*. *Tortulosa pyramidata* (Pfeiffer), (outer view, ×2).
,, 3*b*. ,, ,, ,, (apertural view, ×2).
,, 4*a*. *Tortulosa recurvatus* (Pfeiffer), (outer view, ×2).
,, 4*b*. ,, ,, ,, (apertural view, ×2).
,, 5*a*. *Tortulosa templemani* (Pfeiffer), (outer view, ×2).
,, 5*b*. ,, ,, ,, (apertural view, ×2).
,, 6*a*. *Alycaeus expatriatus* Blanford, (upper side, ×4).
,, 6*b*. ,, ,, ,, (lower side, ×4).
,, 7*a*. *Vivipara bengalensis* s. str. (Lamarck), (outer view).
,, 7*b*. ,, ,, ,, ,, (apertural view).
,, 8*a*. *Vivipara bengalensis* var. *eburnea* Annandale and Sewell, (outer view).
,, 8*b*. ,, ,, ,, ,, ,, ,, ,, (apertural view).

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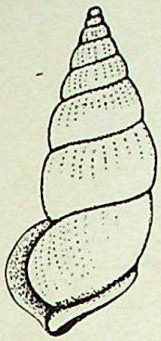

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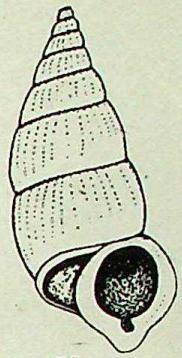

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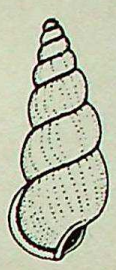

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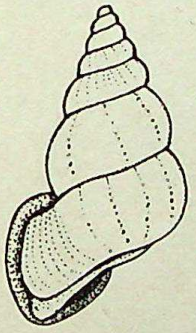

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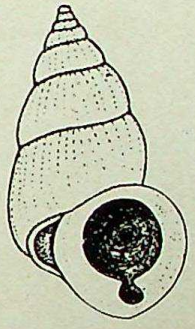

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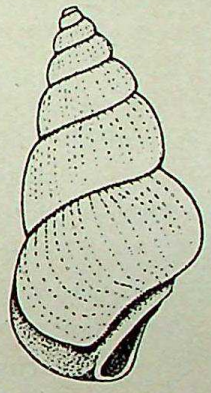

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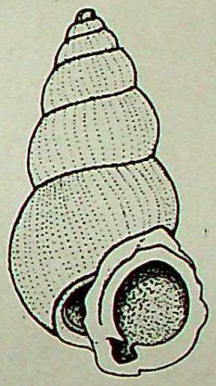

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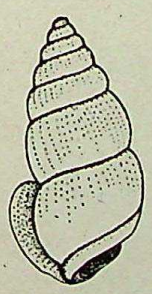

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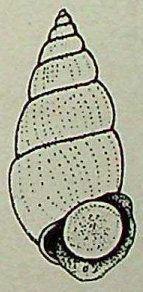

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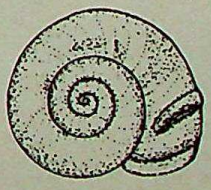

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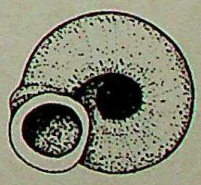
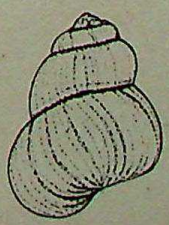


6b

7a

7b



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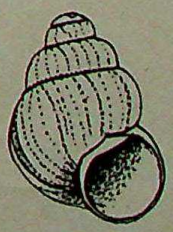

8b

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PLATE IV

Fig. 1*a*. *Vivipara variata* (Frauenfeld), (outer view).
,, 1*b*. ,, ,, ,, (apertural view).
,, 2*a*. *Vivipara dissimilis* (Müller), (outer view).
,, 2*b*. ,, ,, ,, (apertural view).
,, 3*a*. *Pila globosa* (Swainson), (outer view).
,, 3*b*. ,, ,, ,, (apertural view).
,, 3*c*. ,, ,, ,, (operculum).
,, 4*a*. *Pila virens* (Lamarck (outer view).
,, 4*b*. ,, ,, ,, (apertural view of a larger shell).
,, 5*a*. *Mainwaringia paludomoidea* (Nevill), (apertural view, ×5).
,, 5*b*. ,, ,, ,, (outer view, ×5).
,, 6*a*. *Cyclotopsis subdiscoidea* (Sowerby), (upper side).
,, 6*b*. ,, ,, ,, (lower side).

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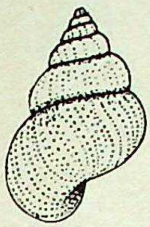

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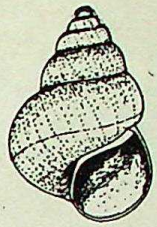

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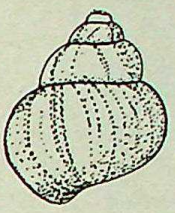

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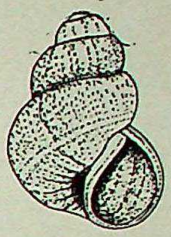

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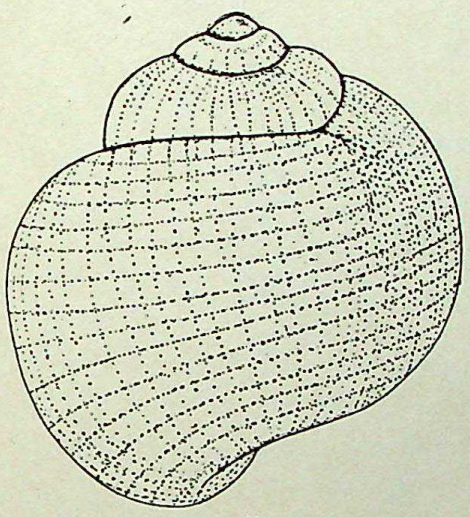

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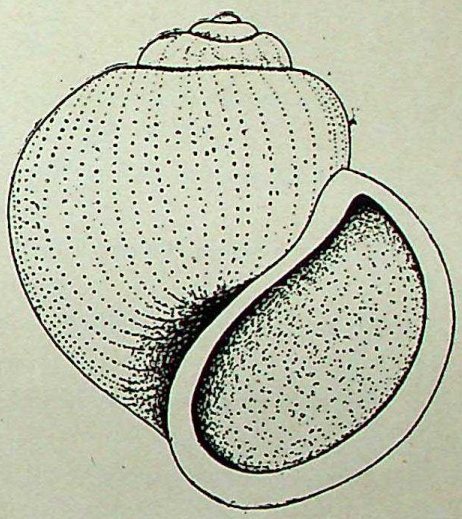

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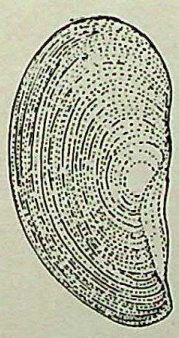

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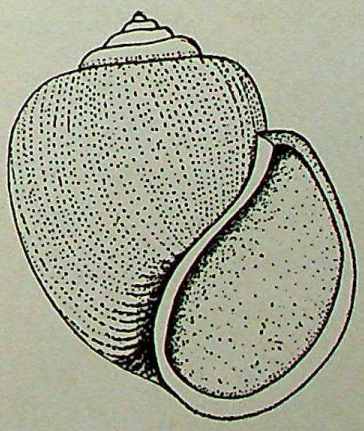

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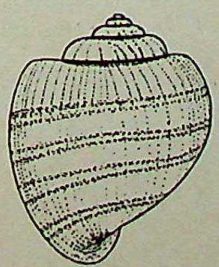

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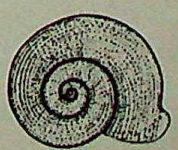

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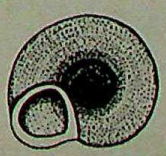

6b

5b

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PLATE V

Fig. 1*a*. *Bithynia stenothyroides* (Dohrn), (outer view, ×2).
,, 1*b*. ,, ,, ,, (apertural view, ×2).
,, 2*a*. *Mysorella costigera* (Kuster), (outer view, ×3).
,, 2*b*. ,, ,, ,, (apertural view, ×3).
,, 3*a*. *Assiminea rubella* Blanford, (outer view, ×5).
,, 3*b*. ,, ,, ,, (apertural view, ×5).
,, 4*a*. *Assiminea brevicula* (Pfeiffer), (outer view, ×5).
,, 4*b*. ,, ,, ,, (apertural view, ×5).
,, 5*a*. *Assiminea woodmasoniana*, Nevill, (outer view, ×5).
,, 5*b*. ,, ,, ,, (apertural view, ×5).
,, 6*a*. *Assiminea hungerfordiana* Nevill, (outer view, ×5).
,, 6*b*. ,, ,, ,, (apertural view, ×5).
,, 7. *Sulcospira* (*Sulcospira*) *hugeli* var. *compacta* (Nevill), (apertural view, ×2).
,, 8*a*. *Sulcospira* (*Sulcospira*) *variabilis* (Benson), (outer view).
,, 8*b*. ,, ,, ,, ,, (apertural view).
,, 9*a*. *Faunus ater* (Linné), (outer view).
,, 9*b*. ,, ,, ,, (apertural view).
,, 10*a*. *Paludomus monile* Hanley, (outer view, ×2).
,, 10*b*. ,, ,, ,, (apertural view, ×2).

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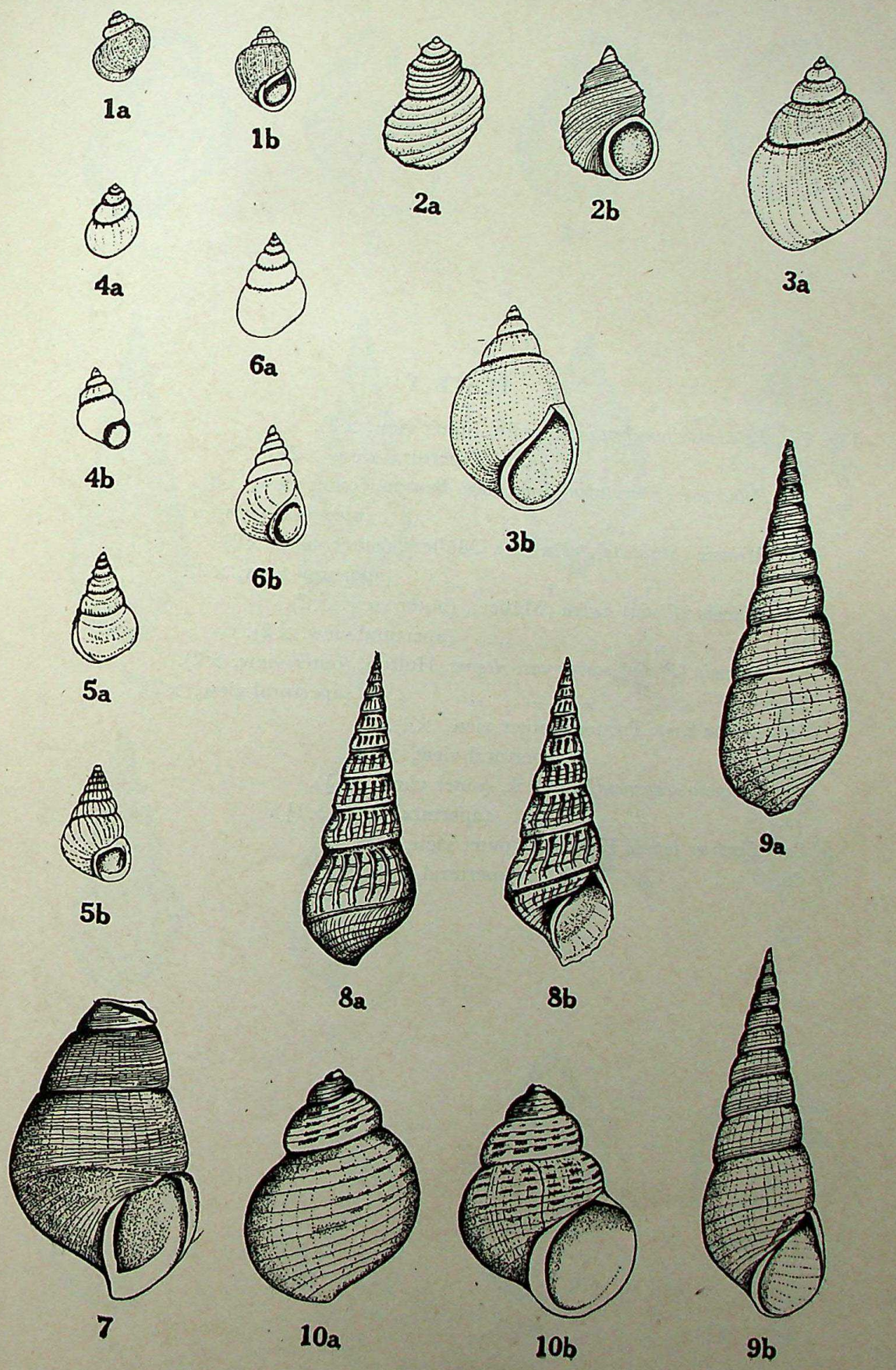

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PLATE VI

Fig. 1*a*. *Paludomus tanschaurica* Gmelin, (outer view, ×2).
„ 1*b*. „ „ „ (apertural view, ×2).
„ 2*a*. *Paludomus* (*Stomatodon*) *stomatodon*, Benson, (outer view, ×2).
„ 2*b*. „ „ „ „ (apertural view, ×2).
„ 3*a*. *Melania* (*Striatella*) *tuberculata* (Müller), (outer view, ×2).
„ 3*b*. „ „ „ „ (apertural view, ×2).
„ 4*a*. *Melania* (*Plotia*) *scabra* (Müller), (outer view, ×2).
„ 4*b*. „ „ „ „ (apertural view, ×2).
„ 5*a*. *Melania* (*Plotia*) *scabra* var. *elegans*, Hutton, (outer view, ×2).
„ 5*b*. „ „ „ „ „ „ (apertural view, ×2).
„ 6*a*. *Litiopa kempi* Preston, (outer view, ×4).
„ 6*b*. „ „ „ (apertural view, ×4).
„ 7*a*. *Lymnaea acuminata* Lamarck, (outer view, ×1½).
„ 7*b*. „ „ „ (apertural view, ×1½).
„ 8*a*. *Lymnaea luteola* Lamarck, (outer view, ×2).
„ 8*b*. „ „ „ (apertural view, ×2).

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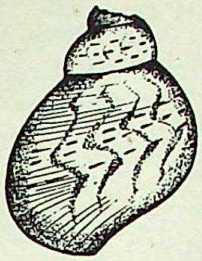

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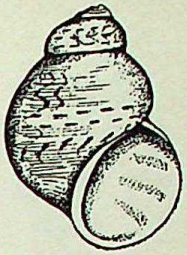

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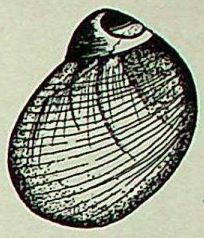

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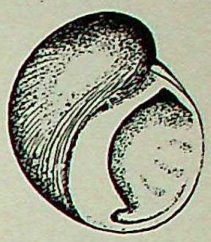

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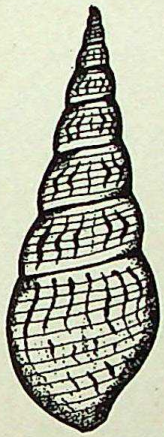

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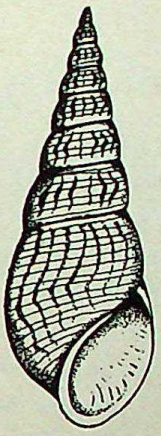

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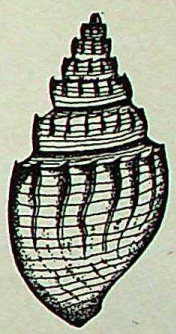

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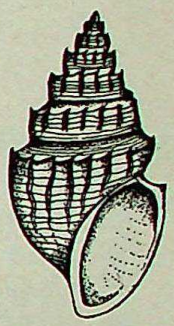

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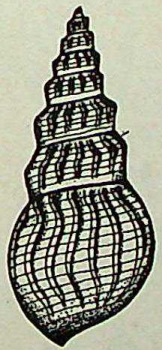

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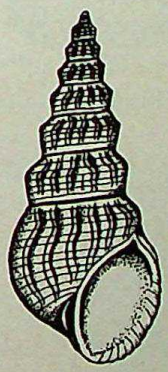

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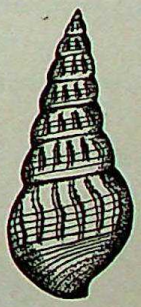

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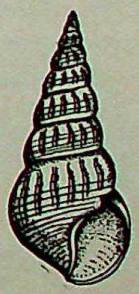

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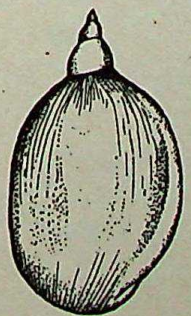

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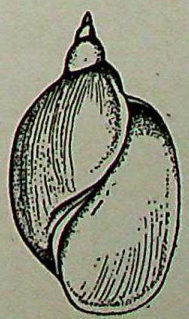

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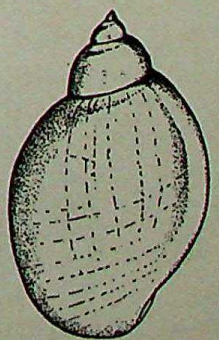

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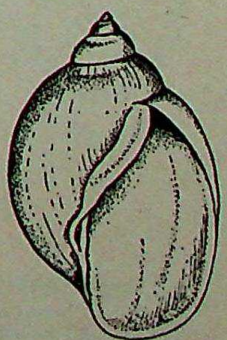

8b

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PLATE VII

Fig. 1*a*. *Lymnaea pinguis* Dohrn, (outer view, ×2).
,, 1*b*. ,, ,, ,, (apertural view, ×2).
,, 2*a*. *Lymnaea stagnalis* Linné, (outer view).
,, 2*b*. ,, ,, ,, (apertural view).
,, 3*a*. *Lymnaea auricularia* (Draparnaud), (outer view, ×1½).
,, 3*b*. ,, ,, ,, (apertural view, ×1½).
,, 4*a*. *Planorbis* (*Indoplanorbis*) *exustus* Deshayes, (upper side, ×2).
,, 4*b*. ,, ,, ,, ,, (lower side, ×2).
,, 4*c*. ,, ,, ,, ,, (side view, ×2).
,, 5*a*. *Anisus* (*Diplodiscus*) *hyptiocyclos* (Benson), (upper side, ×5).
,, 5*b*. ,, ,, ,, ,, (lower side, ×5).
,, 6*a*. *Anisus* (*Gyraulus*) *convexiusculus* (Hutton), (upper side, ×5).
,, 6*b*. ,, ,, ,, ,, (lower side, ×5).
,, 7*a*. *Anisus* (*Gyraulus*) *saigonensis* (Crosse & Fischer), (upper side, ×4).
,, 7*b*. ,, ,, ,, ,, (lower side, ×4).
,, 7*c*. ,, ,, ,, ,, (side view, ×4).

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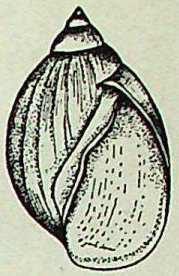
1a



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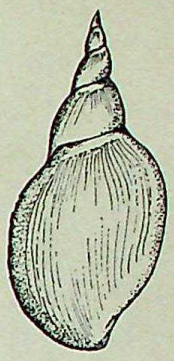
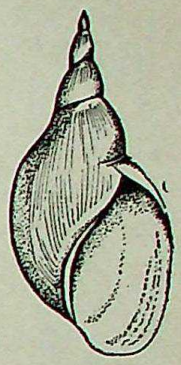


2a



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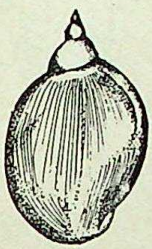

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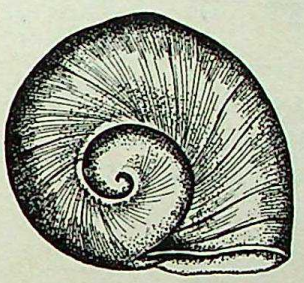

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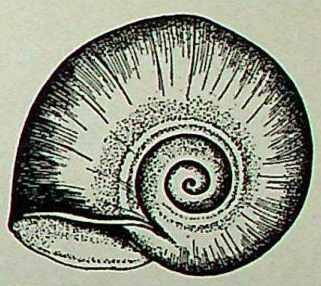

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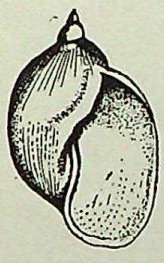

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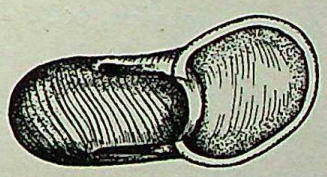

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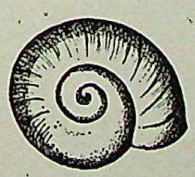

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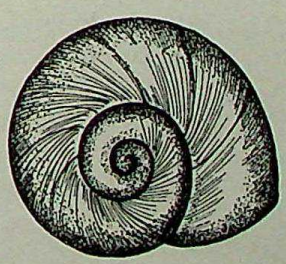
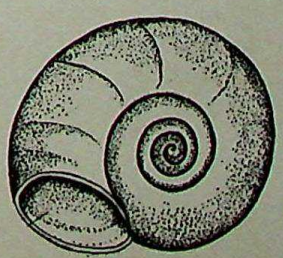


7a

5b

6b



7b

7c

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PLATE VIII

Fig. 1*a*. *Vaginulus alte* Férussac, (dorsal view).
„ 1*b*. „ „ „ (ventral view).
„ 2*a*. *Vaginulus frauenfeldi* Semper, (dorsal view, ×2).
„ 2*b*. „ „ „ (ventral view, ×2).
„ 3*a*. *Succinea gravelyi* Rao, (outer view, ×3).
„ 3*b*. „ „ „ (apertural view, ×3).
„ 4*a*. *Ena* (*Mirus*) *stalix* (Benson), (outer view).
„ 4*b*. „ „ „ „ (apertural view).
„ 5*a*. *Rachis bengalensis* (Lamarck), (outer view, ×2).
„ 5*b*. „ „ „ (apertural view, ×2).
„ 6. *Rachis praetermissus* (Blanford), (outer view, ×2).
„ 7*a*. *Rachis pulcher* (Gray), (outer view, ×2).
„ 7*b*. „ „ „ (apertural view, ×2).
„ 8*a*. *Rachis punctatus* (Anton), (outer view, ×2).
„ 8*b*. „ „ „ (apertural view, ×2).
„ 9*a*. *Cerastus malabaricus* (Pfeiffer), (outer view).
„ 9*b*. „ „ „ (apertural view).
„ 10*a*. *Cerastus jerdoni* (Reeve), (outer view).
„ 10*b*. „ „ „ (apertural view).

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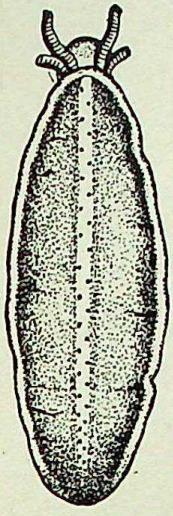

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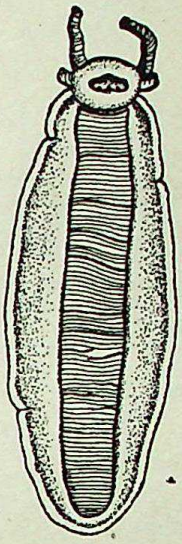

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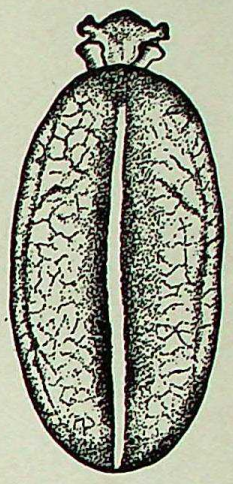

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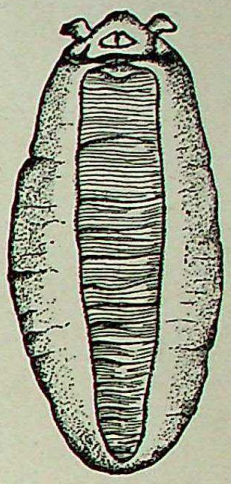

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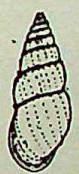
3a

3b

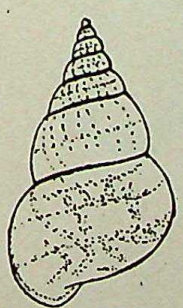


4a

4b

5a

5b



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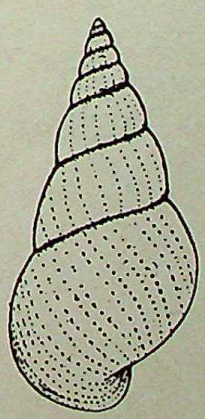

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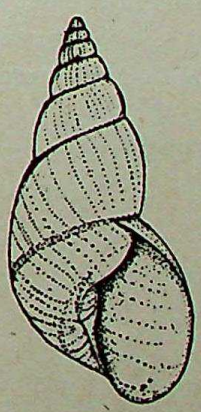


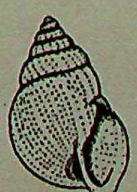
7b

8a

9a

9b

10a



10b

8b

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PLATE IX

Fig. 1*a*. *Glessula mullorum* (Blanford), (outer view, ×3).
,, 1*b*. ,, ,, ,, (apertural view, ×3).
,, 2*a*. *Glessula paupercula* (Blanford), (outer view, ×3).
,, 2*b*. ,, ,, ,, (apertural view, ×3).
,, 3*a*. *Glessula tornensis* (Blanford), (outer view).
,, 3*b*. ,, ,, ,, (apertural view).
,, 4*a*. *Glessula tenuispira* (Benson), (outer view).
,, 4*b*. ,, ,, ,, (apertural view).
,, 5*a*. *Glessula perrotteti* (Pfeiffer), (outer view, ×1½).
,, 5*b*. ,, ,, ,, (apertural view, ×1½).
,, 6*a*. *Subulina octona* (Bruguière), (outer view, ×2).
,, 6*b*. ,, ,, ,, (apertural view, ×2).
,, 7*a*. *Opeas gracile* (Hutton), (outer view, ×2).
,, 7*b*. ,, ,, ,, (apertural view, ×2).
,, 8*a*. *Opeas annandalei* Godwin-Austen, (outer view, ×2).
,, 8*b*. ,, ,, ,, (apertural view, ×2).
,, 9*a*. *Zootecus chion* (Pfeiffer), (outer view, ×2).
,, 9*b*. ,, ,, ,, (apertural view, ×2).

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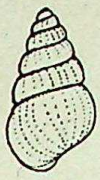

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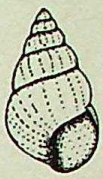
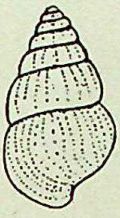


1b

2a

2b



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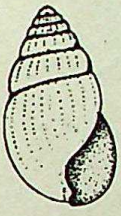

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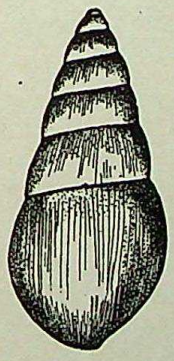
4a

4b



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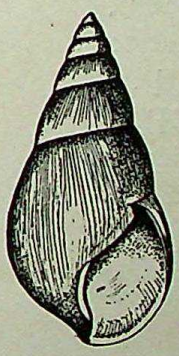

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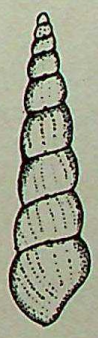

6a

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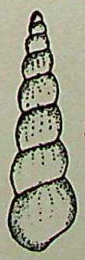

7a

7b

8a

8b

9a

9b

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PLATE X

Fig. 1*a*. *Achatina fulica* (Férussac), (outer view).
,, 1*b*. ,, ,, ,, (apertural view).
,, 2*a*. *Thysanota guerini* (Pfeiffer), (side view, ×2).
,, 2*b*. ,, ,, ,, (upper side, ×2).
,, 2*c*. ,, ,, ,, (lower side, ×2).
,, 3*a*. *Ruthvenia retifera* (Pfeiffer), (side view, ×4).
,, 3*b*. ,, ,, ,, (upper side, ×4).
,, 3*c*. ,, ,, ,, (lower side, ×4).
,, 4*a*. *Corilla adamsi* Gude, (upper side, ×1½).
,, 4*b*. ,, ,, ,, (lower side, ×1½).
,, 5*a*. *Corilla beddomeae* (Hanley), (upper side, ×2).
,, 5*b*. ,, ,, ,, (lower side, ×2).
,, 5*c*. ,, ,, ,, (side view, 2).

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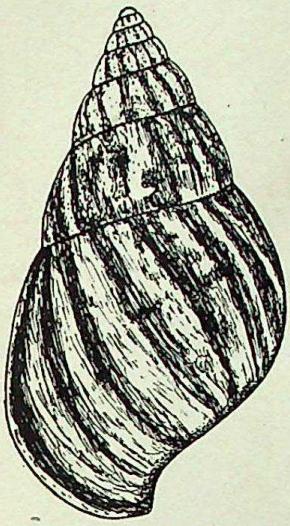

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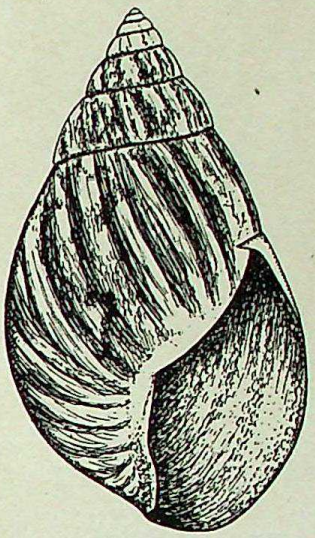
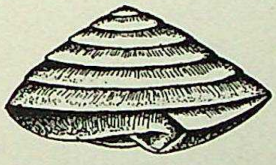


1b

2a

2b



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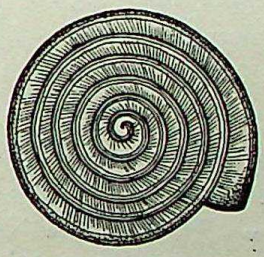

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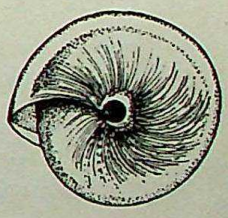

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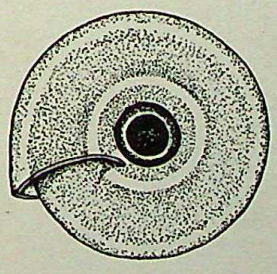

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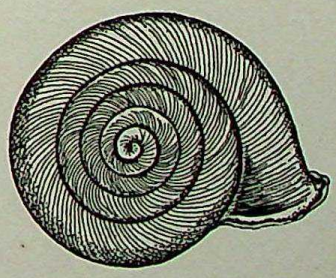

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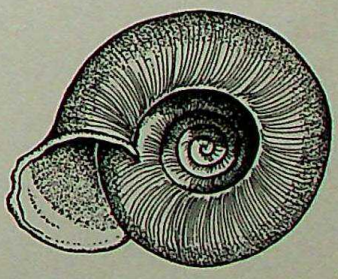

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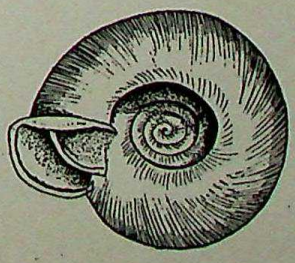

5b

5c

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PLATE XI

Fig. 1*a*. *Corilla gudei* Sykes, (upper side, ×1½).
,, 1*b*. ,, ,, ,, (lower side, ×1½).
,, 1*c*. ,, ,, ,, (side view, ×1½).
,, 2*a*. *Corilla fryae* Gude, (upper side, ×1½).
,, 2*b*. ,, ,, ,, (lower side, ×1½).
,, 3*a*. *Corilla erronea* Albers, (upper side, ×1½).
,, 3*b*. ,, ,, ,, (lower side, ×1½).
,, 3*c*. ,, ,, ,, (side view, ×1½).
,, 4*a*. *Corilla carabinata* Férussac, (upper side, ×1½).
,, 4*b*. ,, ,, ,, (lower side, ×1½).
,, 4*c*. ,, ,, ,, (side view, ×1½).
,, 5. *Kaliella barrakporensis* (Pfeiffer), (side view, ×10).
,, 6*a*. *Macrochlamys aulopsis* (Benson), (side view, ×3).
,, 6*b*. ,, ,, ,, (upper side, ×3).

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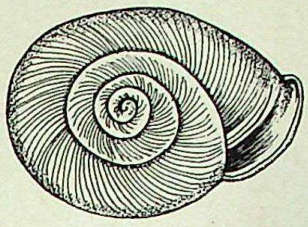

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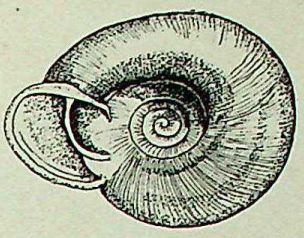

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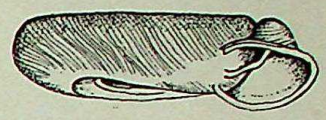

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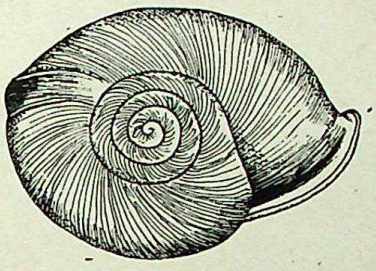

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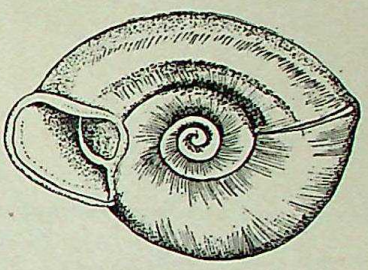

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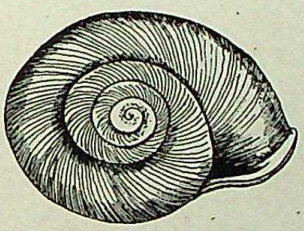

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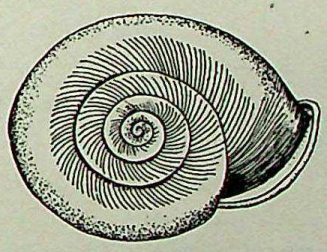

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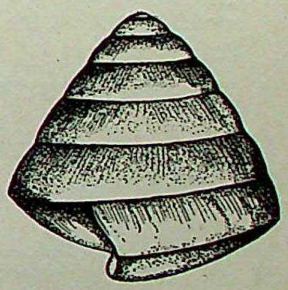

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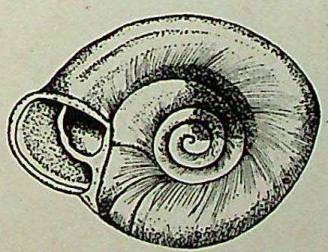

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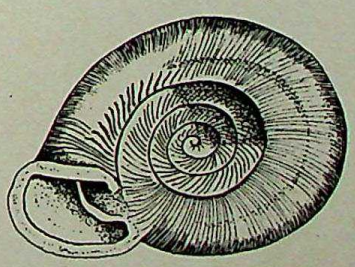

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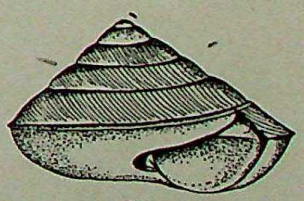

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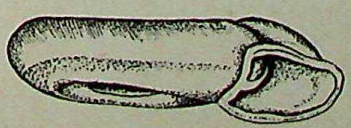

3c

4c

6b

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PLATE XII

Fig. 1*a*. *Macrochlamys lixa* (Blanford), (side view, ×3).
,, 1*b*. ,, ,, ,, (upper side, ×3).
,, 1*c*. ,, ,, ,, (lower side, ×3).
,, 2*a*. *Macrochlamys woodiana* (Pfeiffer), (side view, ×3).
,, 2*b*. ,, ,, ,, (upper side, ×3).
,, 2*c*. ,, ,, ,, (lower side, ×3).
,, 3*a*. *Macrochlamys vilipensa* (Benson), (side view, ×4).
,, 3*b*. ,, ,, ,, (upper side, ×4).
,, 4*a*. *Euplecta layardi* (Pfeiffer), (side view, ×2).
,, 4*b*. ,, ,, ,, (upper side, ×2).
,, 4*c*. ,, ,, ,, (lower side, ×2).
,, 5*a*. *Euplecta subdecussata* (Pfeiffer), (side view, ×2).
,, 5*b*. ,, ,, ,, (upper side, ×2).
,, 5*c*. ,, ,, ,, (lower side, ×2).

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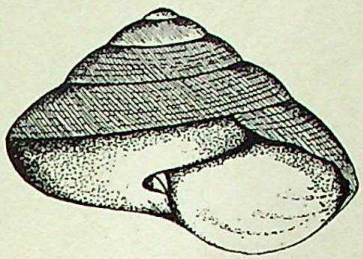

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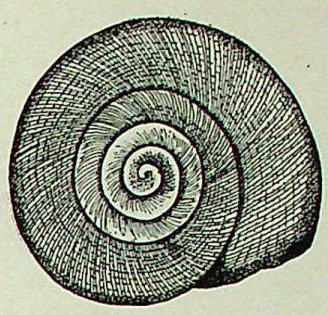

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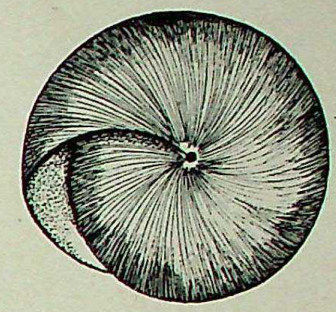

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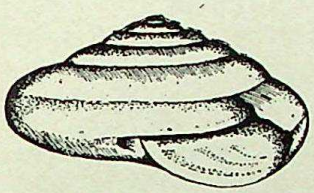

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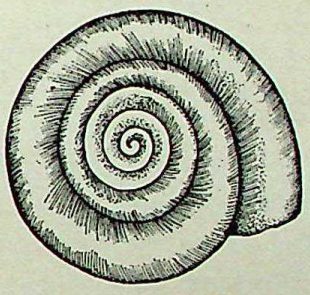

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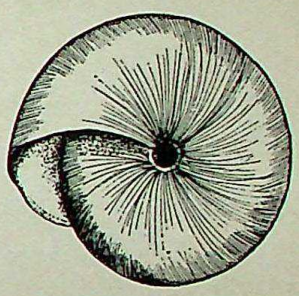

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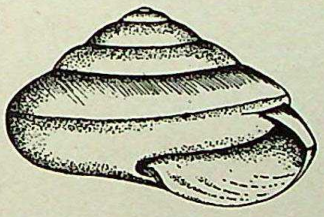

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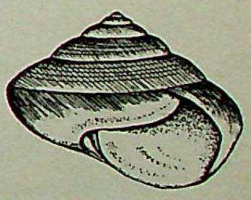

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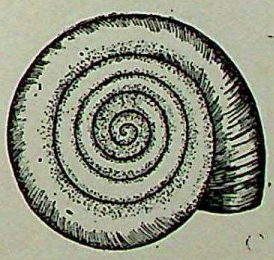

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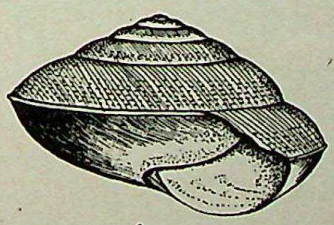

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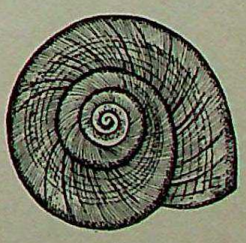

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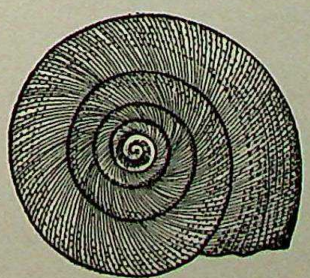

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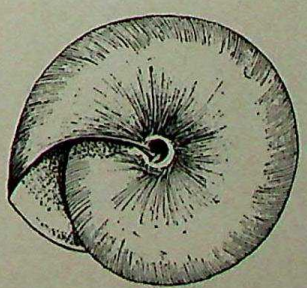

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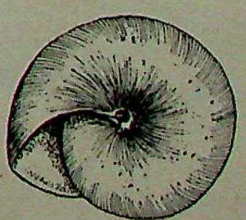

5c

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PLATE XIII

Fig. 1*a*. *Euplecta semidecussata* (Pfeiffer), (side view).
,, 1*b*. ,, ,, ,, (upper side).
,, 2*a*. *Euplecta travancorica* (Benson), (side view, $\times 1\frac{1}{2}$).
,, 2*b*. ,, ,, ,, (upper side, $\times 1\frac{1}{2}$).
,, 3*a*. *Euplecta indica* (Pfeiffer), (side view, $\times 1\frac{1}{2}$).
,, 3*b*. ,, ,, ,, (upper side, $\times 1\frac{1}{2}$).
,, 4*a*. *Euplecta indica* var. *shiplayi* (Pfeiffer), side view, $\times 1\frac{1}{2}$).
,, 4*b*. ,, ,, ,, ,, ,, (upper side, $\times 1\frac{1}{2}$).
,, 4*c*. ,, ,, ,, ,, ,, (lower side, $\times 1\frac{1}{2}$).
,, 5*a*. *Euplecta gardeneri* (Pfeiffer), (side view, $\times 1\frac{1}{2}$).
,, 5*b*. ,, ,, ,, (upper side, $\times 1\frac{1}{2}$).
,, 6. *Euplecta acuducta* (Benson), (side view, $\times 3$).

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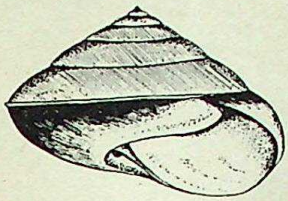

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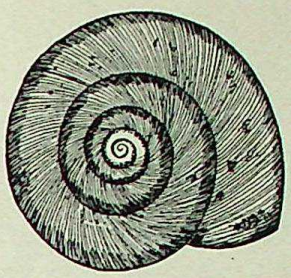

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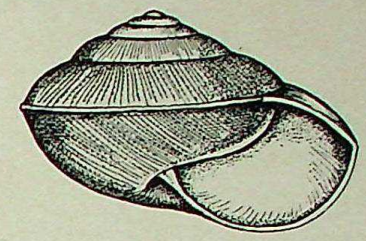

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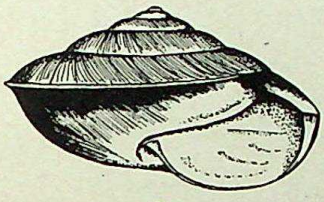

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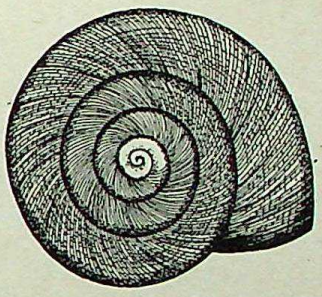

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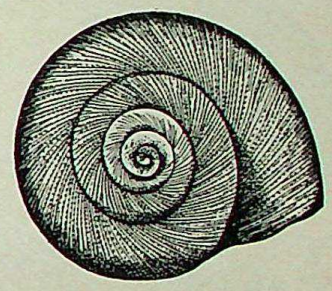

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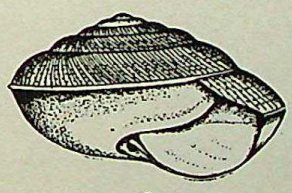

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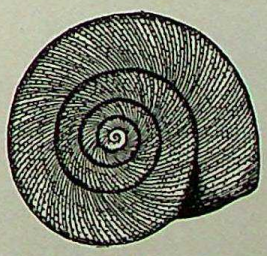

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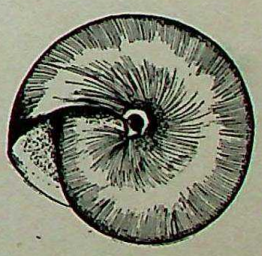

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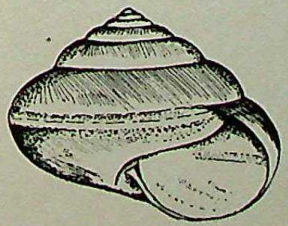

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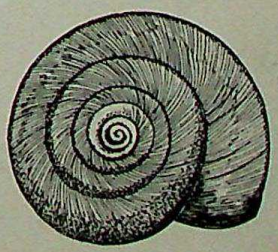

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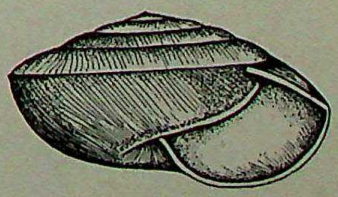

6

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PLATE XIV

Fig. 1*a*. *Euplecta hyphasma* (Pfeiffer), (side view, ×2).
,, 1*b*. ,, ,, ,, (upper side, ×2).
,, 2*a*. *Euplecta* sp. near *sisparica* (Blanford), (side view, ×2).
,, 2*b*. ,, ,, ,, ,, ,, (upper side, ×2).
,, 3*a*. *Hemiplecta basileus* (Benson), (side view).
,, 3*b*. ,, ,, ,, (upper side).
,, 4*a*. *Hemiplecta beddomei* Blanford, (side view).
,, 4*b*. ,, ,, ,, (upper side).

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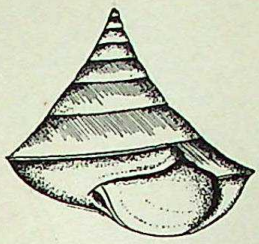

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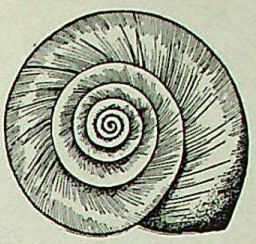

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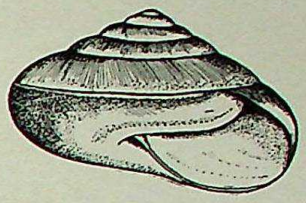

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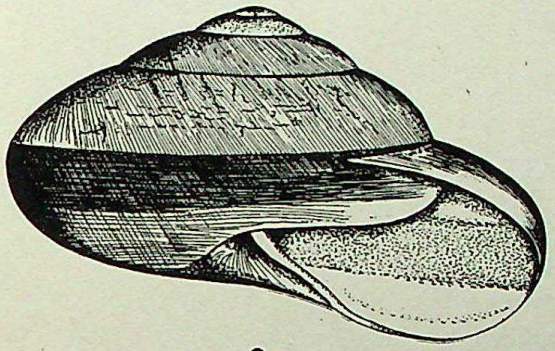

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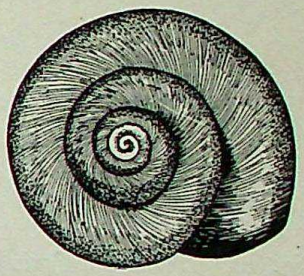

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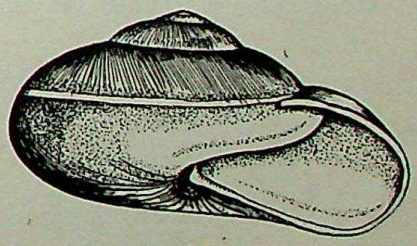

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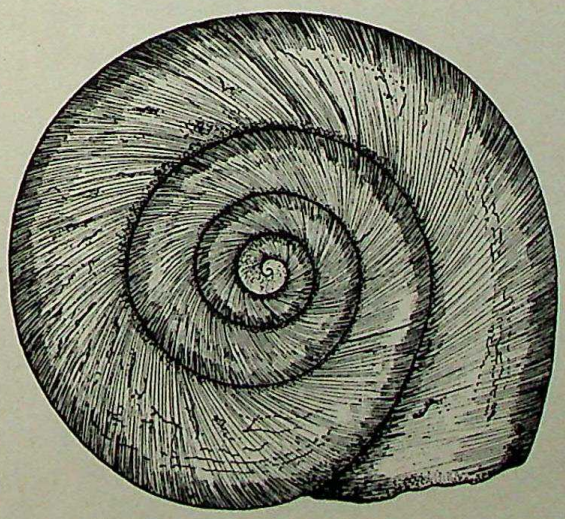

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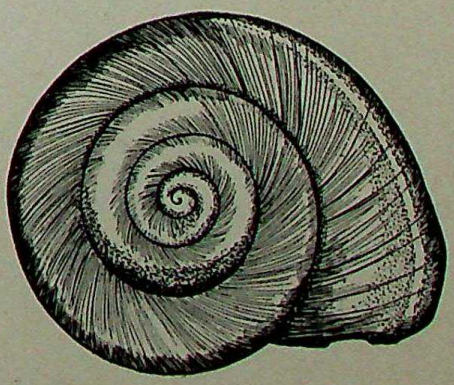

4b

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PLATE XV

Fig. 1*a*. *Cryptozona ligulata* (Férussac), (side view).
,, 1*b*. ,, ,, ,, (upper side).
,, 1*c*. ,, ,, ,, (lower side).
,, 2*a*. *Cryptozona* (*Xestina*) *belangeri* (Deshayes), (side view).
,, 2*b*. ,, ,, ,, ,, (upper side).
,, 3*a*. *Cryptozona* (*Xestina*) *albata* (Blanford), (side view, $\times 1\frac{1}{2}$).
,, 3*b*. ,, ,, ,, ,, (upper side $\times 1\frac{1}{2}$).
,, 4*a*. *Cryptozona* (*Xestina*) *bistrialis* (Beck), (side view).
,, 4*b*. ,, ,, ,, ,, (upper side).

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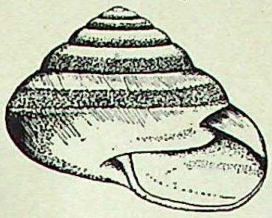
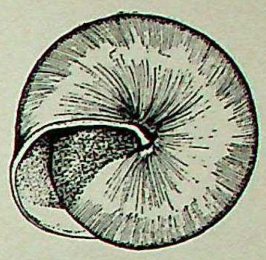


1a

1b



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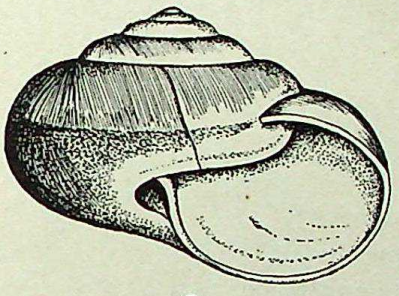

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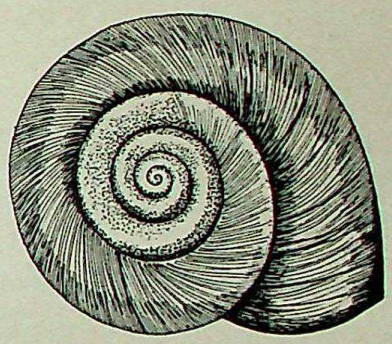

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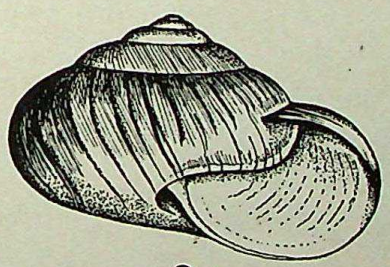

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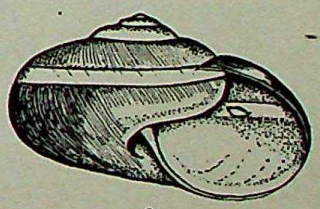

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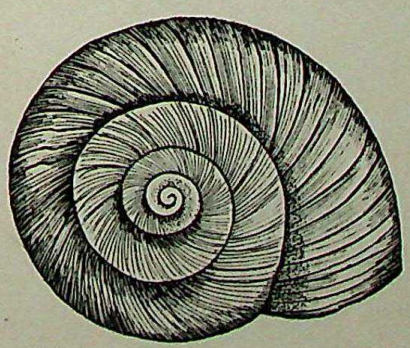
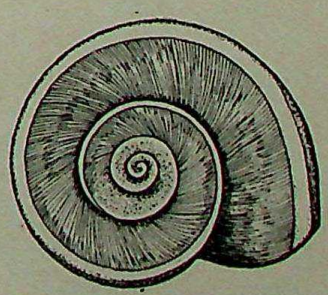


3b



4b

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PLATE XVI

Fig. 1*a*. *Cryptozona* (*Nilgiria*) *semirugata* (Beck), (side view).
,, 1*b*. ,, ,, ,, ,, (upper side).
,, 2*a*. *Cryptozona* (*Nilgiria*) *maderaspatana* (Gray), (upper side, $\times 1\frac{1}{2}$).
,, 2*b*. ,, ,, ,, ,, (side view $\times 1\frac{1}{2}$).
,, 3*a*. *Ariophanta kadapaensis* (Nevill), (side view).
,, 3*b*. ,, ,, ,, (upper side).
,, 4*a*. *Ariophanta thyreus* (Benson), (side view).
,, 4*b*. ,, ,, ,, (upper side).
,, 4*c*. ,, ,, ,, (lower side).
,, 5*a*. *Ariophanta thyreus* var. *ryssolemma* (Albers), (side view).
,, 5*b*. ,, ,, ,, ,, ,, (upper side).

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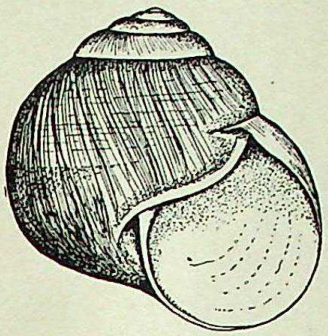

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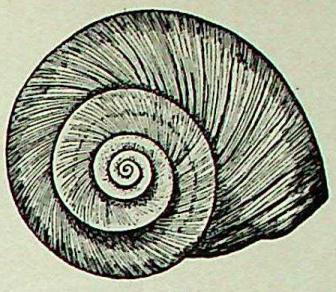

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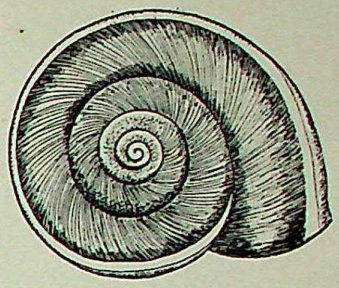

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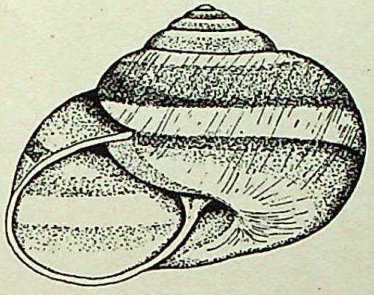

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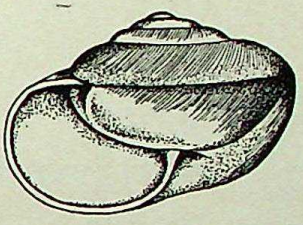

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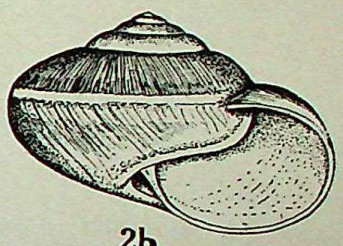

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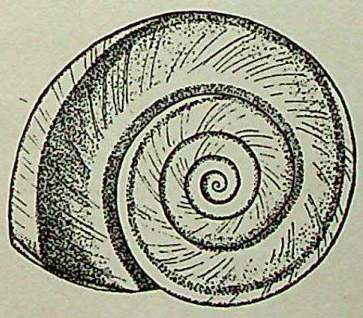

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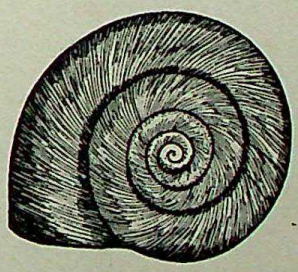

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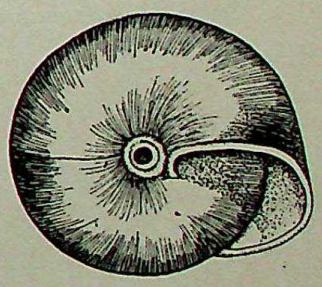

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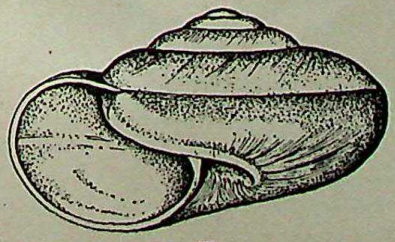

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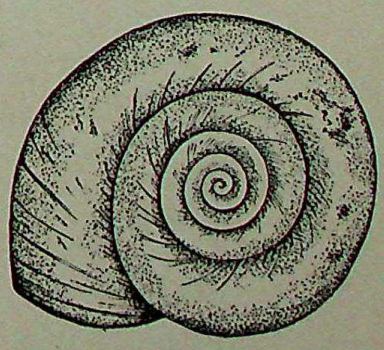

5b

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PLATE XVII

Fig. 1*a*. *Ariophanta cysis* (Benson), (side view).
,, 1*b*. ,, ,, ,, (upper side).
,, 2*a*. *Indrella ampulla* (Benson), (upper side of shell).
,, 2*b*. ,, ,, ,, (side view of shell).
,, 2*c*. ,, ,, ,, (shell with animal *in situ*).
,, 3*a*. *Mariaella dussumieri* Gray, (side view).
,, 3*b*. ,, ,, ,, (dorsal view).

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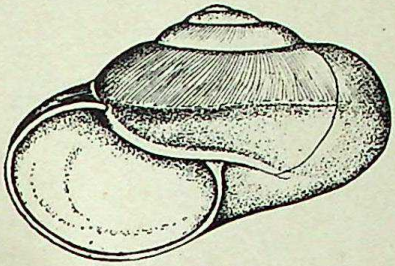

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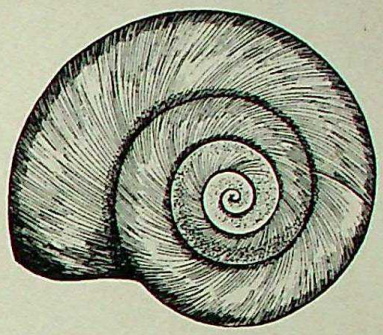

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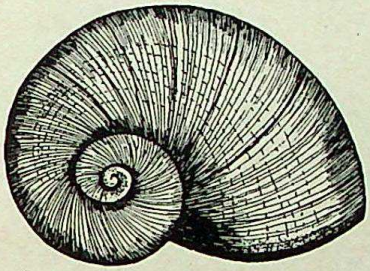

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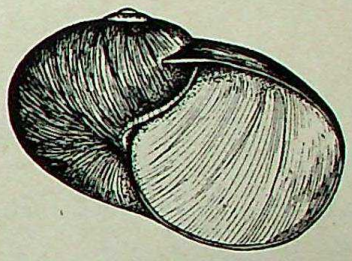

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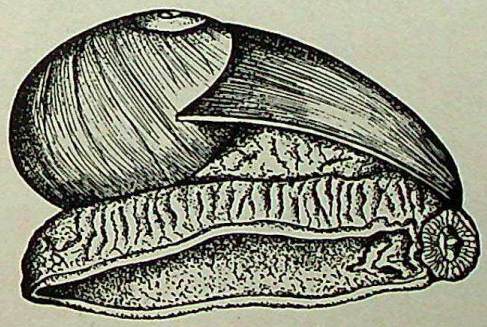

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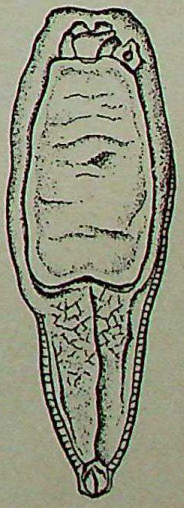

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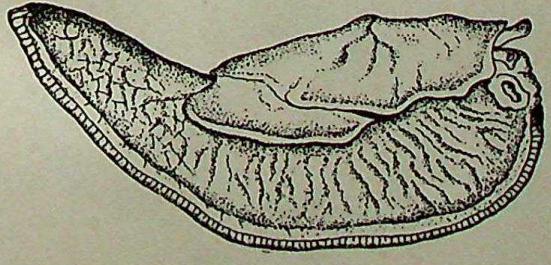

3a

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PLATE XVIII

Fig. 1*a*. *Mariaella beddomei* Godwin-Austen, (side view).
,, 1*b*. ,, ,, ,, (dorsal view).
,, 2*a*. *Acavus haemastoma* (Linné), (side view, $\times 1\frac{1}{2}$).
,, 2*b*. ,, ,, ,, (upper side, $\times 1\frac{1}{2}$).
,, 3*a*. *Acavus waltoni* (Reeve), (side view).
,, 3*b*. ,, ,, ,, (upper side).
,, 4*a*. *Acavus skinneri* (Reeve), (side view).
,, 4*b*. ,, ,, ,, (upper side).

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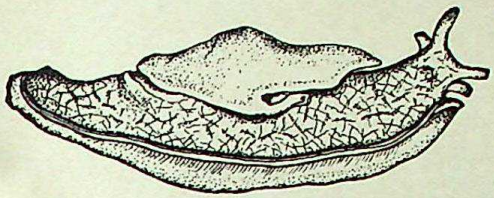
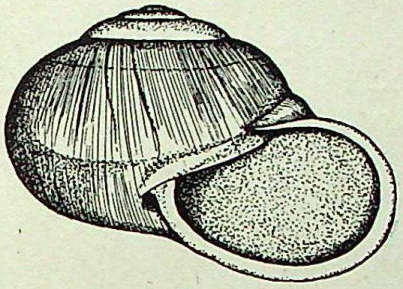


1a

1b



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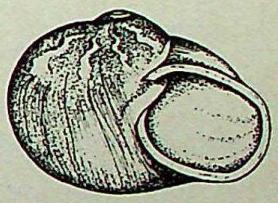

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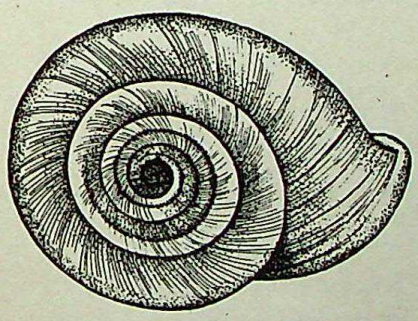

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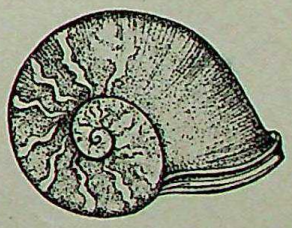

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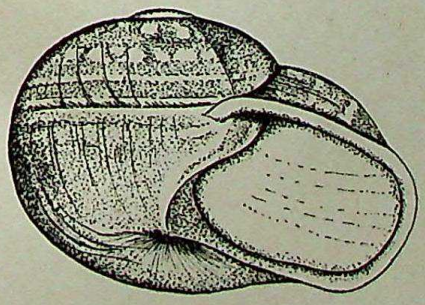

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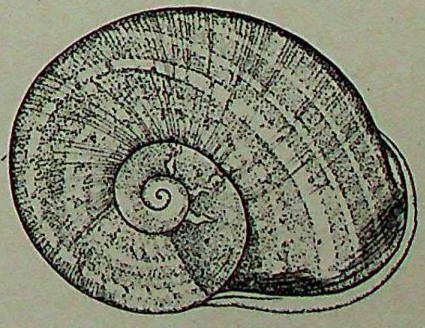

3b

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PLATE XIX

Fig. 1*a*. *Planispira fallaciosa* (Férussac), (side view, ×2).
,, 1*b*. ,, ,, ,, (upper side, ×2).
,, 1*c*. ,, ,, ,, (lower side, ×2).
,, 2*a*. *Planispira vittata* (Müller), (side view, ×1½).
,, 2*b*. ,, ,, ,, (upper side, ×1½).
,, 3*a*. *Planispira nilagerica* (Pfeiffer), (side view, ×2).
,, 3*b*. ,, ,, ,, (upper side, ×2).
,, 3*c*. ,, ,, ,, (lower side, ×2).
,, 4*a*. *Amphidromus* (*Beddomea*) *intermedius* (Pfeiffer), (outer view).
,, 4*b*. ,, ,, ,, ,, (apertural view).
,, 5*a*. *Streptaxis peroteti* (Petit), (side view, ×3).
,, 5*b*. ,, ,, ,, (upper side, ×3).
,, 6*a*. *Ptychotrema* (*Ennea*) *bicolor* (Hutton), (outer view, ×5).
,, 6*b*. ,, ,, ,, ,, (apertural view, ×5).
,, 7*a*. *Ptychotrema* (*Ennea*) *bicolor* race *barkudensis* (Annandale & Prashad), (outer view, ×5).
,, 7*b*. ,, ,, ,, ,, ,, ,, ,, (apertural view, ×5).
,, 8*a*. *Ptychotrema* (*Ennea*) *subcostulata* (Blanford), (outer view, ×5).
,, 8*b*. ,, ,, ,, ,, (apertural view, ×5).

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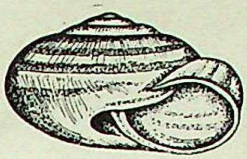

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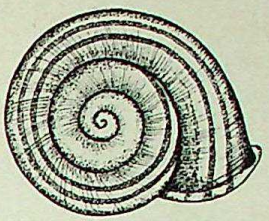

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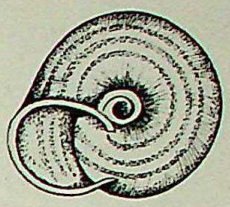

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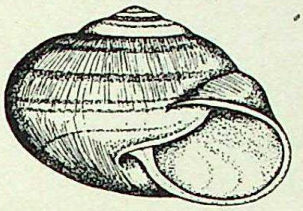

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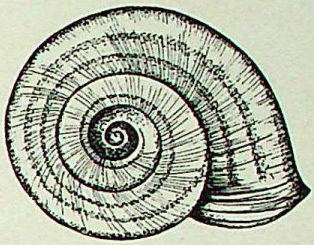

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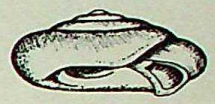

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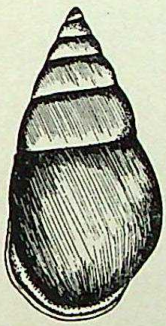

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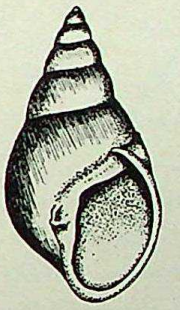

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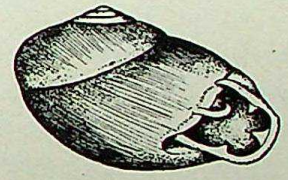
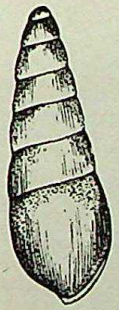


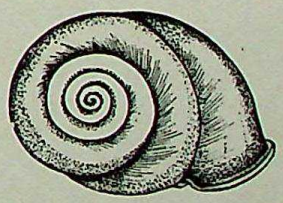
5a

3b



6a

6b



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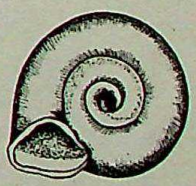
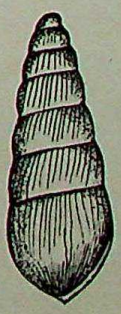


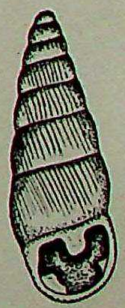
3c

7a

7b



8a



8b

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PLATE XX

Fig. 1*a*. *Parreysia* (*Parreysia*) *corrugata* var. *nagpoorensis* (Lea), (outer view).
,, 1*b*. ,, ,, ,, ,, ,, ,, (inner view of the same valve).
,, 2*a*. *Parreysia* (*Parreysia*) *wynegungaënsis* (Lea), (outer view).
,, 2*b*. ,, ,, ,, ,, (inner view of the same valve).
,, 3*a*. *Lamellidens marginalis* (Lamarck), (outer view of right valve).
,, 3*b*. ,, ,, ,, (inner view of left valve).
,, 4*a*. *Lamellidens corrianus* (Lea), (outer view of left valve, $\times 1\frac{1}{3}$).
,, 4*b*. ,, ,, ,, (inner view of right valve, $\times 1\frac{1}{3}$).

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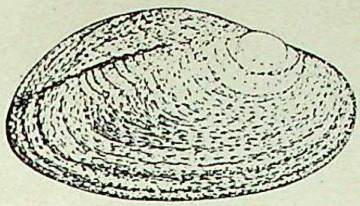

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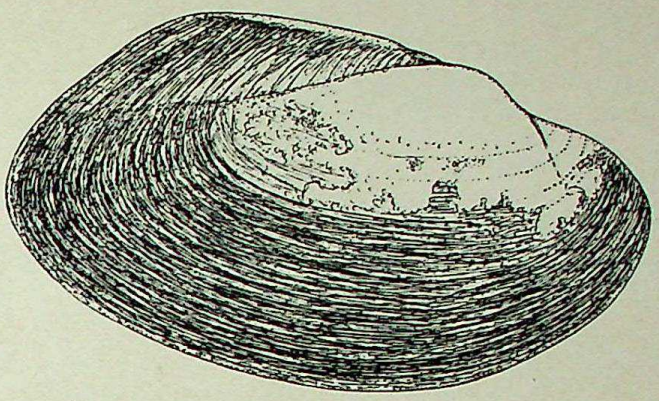

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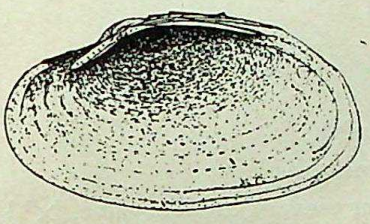

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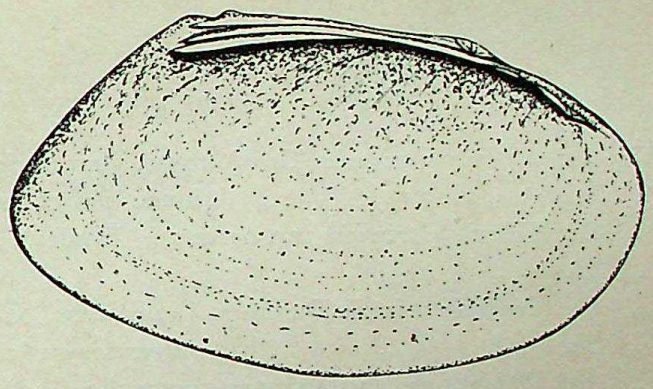

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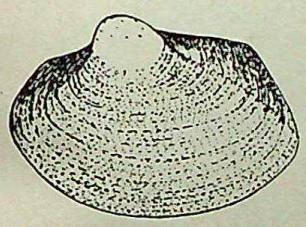

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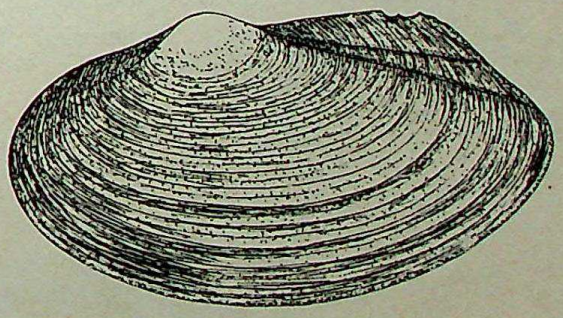

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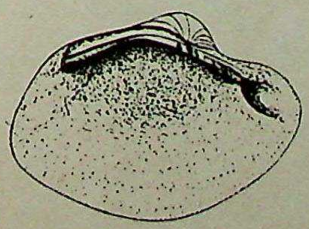

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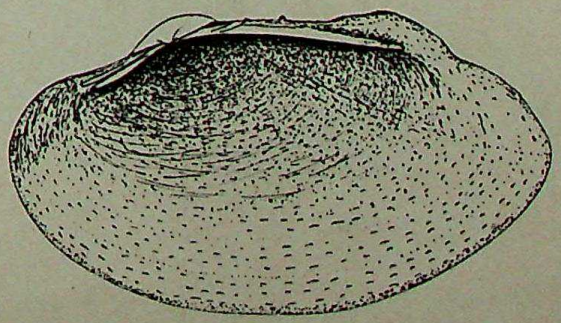

4b

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PLATE XXI

Fig. 1*a*. *Villorita cyprinoides* (Gray), (outer view of right valve).
,, 1*b*. ,, ,, ,, (inner view of the same valve).
,, 2*a*. *Villorita cyprinoides* var. *cochinensis* (Hanley), (outer view of the left valve, $\times 1\frac{1}{2}$).
,, 2*b*. ,, ,, ,, ,, ,, (inner view of the same valve, $\times 1\frac{1}{2}$).
,, 3*a*. *Corbicula striatella* Deshayes, (outer view, $\times 2$).
,, 3*b*. ,, ,, ,, (inner view of the same valve, $\times 2$).
,, 4*a*. *Corbicula occidens* Deshayes, (outer view, $\times 2$).
,, 4*b*. ,, ,, ,, (inner view of the same valve, $\times 2$).
,, 5*a*. *Corbicula regularis* Prime, (outer view, $\times 2$).
,, 5*b*. ,, ,, ,, (inner view of the same valve, $\times 2$).

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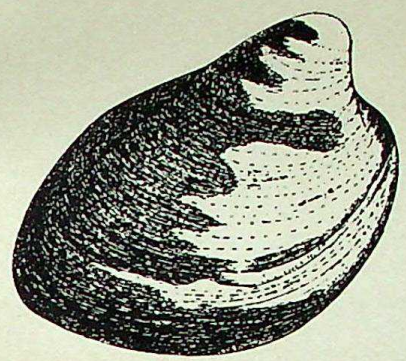

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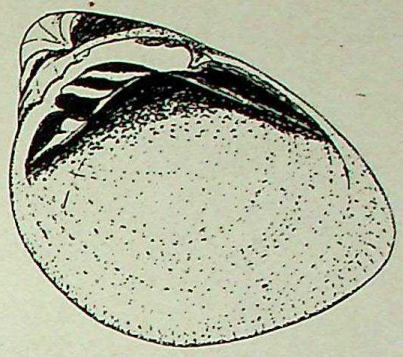

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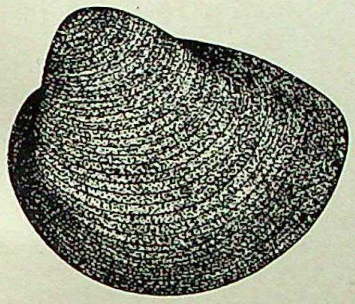

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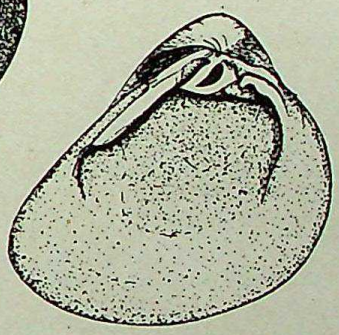

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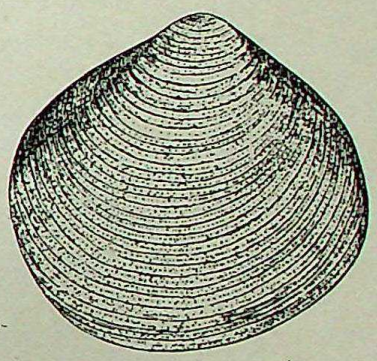

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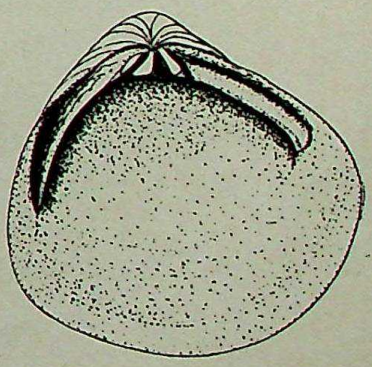

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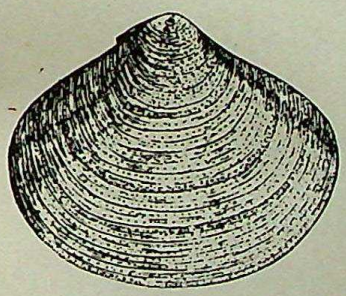

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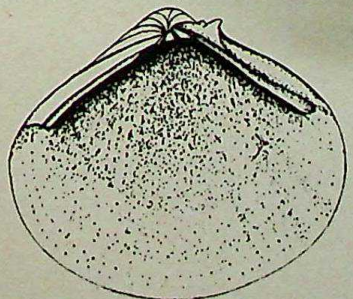

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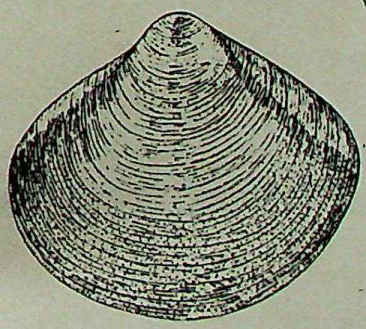

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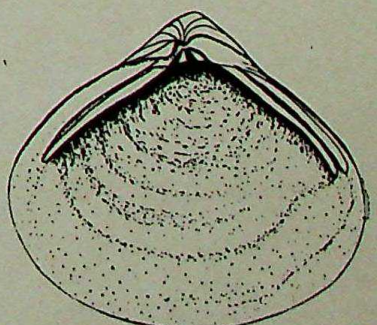

5b

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